SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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ON LAND AND ON WATER: MOTORING WITH THE AMPHIBIOUS GLIDING BOATS.—[See page 306]

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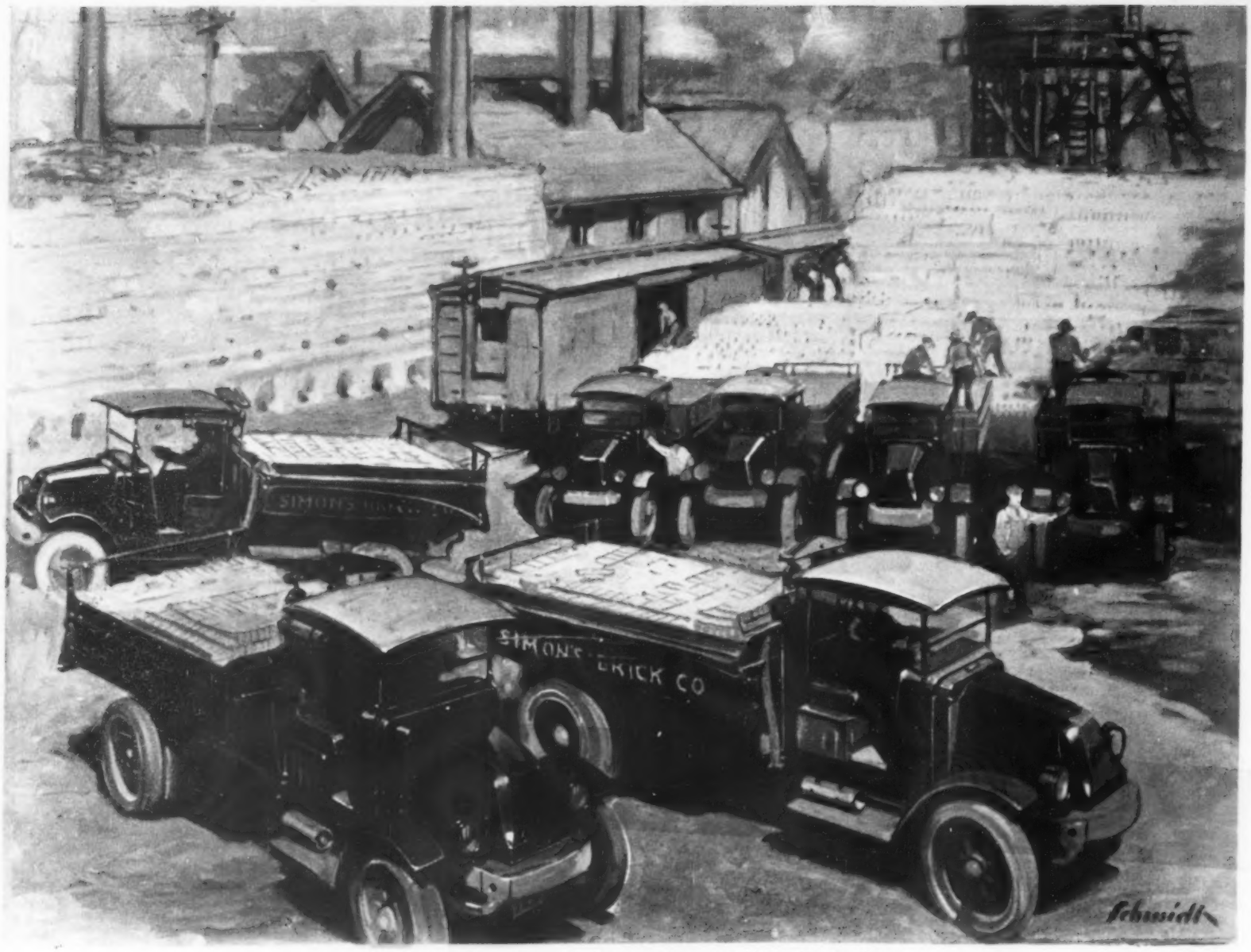

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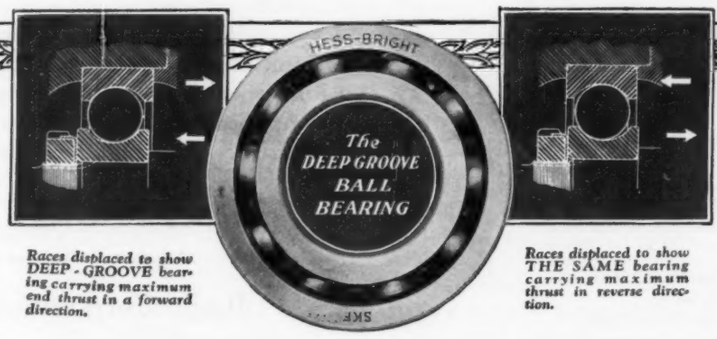

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With the Editors

SEVERAL months ago we received a most unusual invitation. Sir Arthur Conan Doyle, who has taken a keen interest in our psychic investigation from the very beginning, suggested that we might appoint a representative in Europe to tour the psychic centers of England and the Continent, under Sir Arthur's personal auspices. Needless to say, such an invitation was invaluable. For one thing, Sir Arthur has the friendship and confidence of all the leading psychic workers and could introduce us to the most guarded circles. In this manner we could obtain first-hand impressions regarding European psychic investigators, their mediums, the results obtained, and last, but by no means least, the methods of control, if any, that are being employed. With our American investigation now under way, we have sought to perfect the technique of our electrical, mechanical and photographic control; for our work, as so often announced, is to have the stamp of scientific merit no matter what may be achieved in the way of definite results. Obviously, a close study of leading mediums at work must prove of the utmost value in preparing the proper test conditions for our American sittings.

AT any rate, we selected Mr. J. Malcolm Bird of our editorial staff, who is also secretary to our committee in charge of our psychic investigation, for this interesting and most important assignment. Of a mathematical and highly analytical turn of mind, thoroughly scientific in his observations, most unemotional in character, and a clear, concise and logical reporter of facts as he finds them, Mr. Bird is the right man for such a difficult task, wherein the reader must depend on the reporter to deliver the true facts in the case without distortion of any kind. In this issue there appears the first report from Mr. Bird, based on two sittings with a Scottish medium in London, together with our editorial comments on page 300. Following his investigation in England, Mr. Bird visited the French and German psychic centers, returning to England in time to sail for home in the company of Sir Arthur Conan Doyle, who has come to this country to deliver a new series of lectures on his psychic views.

BECAUSE of the unusual amount of space which the newspapers have devoted to the discovery of Tut-ankh-Amen's tomb in Egypt, it is difficult for the laity to form a just conception of the importance of this latest archæological "find." True, the discovery of this royal tomb at Thebes is unquestionably the most interesting that has ever been made in Egypt: never before in the history of archæological exploration has an unrifled royal tomb been found, so that every feature of this wonderful discovery is virtually new. Still, numerous other tombs have been unearthed in the recent and dim past. It was with a view to establishing the relative importance of the Tut-ankh-Amen discovery in the broad field of Egyptology that we asked Mr. T. George Allen, secretary of the Haskell Oriental Museum and the Oriental Institute, University of Chicago, to write for us. In his article entitled "Tutenkhamon's Tomb," Mr. Allen has reviewed the leading Egyptian archæological discoveries down through the ages, and has pointed out the leading features of the present "find." Meanwhile, we have had our artist reconstruct a comprehensive and thoroughly authenticated view of the tomb and its relation to other tombs in the Valley of the Tombs of the Kings. Mr. Allen spells the Pharaoh's name as "Tutenkhamon," and we have retained his spelling throughout his interesting article. In connection with our own drawing, however, we have retained our own spelling, "Tut-ankh-Amen." As King Tut-ankh-Amen's name is appearing in various spellings, it should be explained that the ancient Egyptian language writes only consonants. The Egyptologist, thus given only the bare skeleton of the name to work upon, has had to supply his own vowels. Hence the wide variation in the spelling of the famous name—or, in plain language, one guess is as good as another!

A PLAY current in New York calls for an expert on emeralite uses in paint—whatever that may mean—and to cloak him with proper authority, the playwright has billed him as a famous writer on this subject in the SCIENTIFIC AMERICAN! In a current fiction magazine the leading character of a story is forever quoting the SCIENTIFIC AMERICAN to emphasize the weight of his arguments! Odd but complimentary uses for our good name, to be sure.

FORECASTING the leading features of our next issue, the June issue, we come across a highly interesting story of the automobile thief and how he works, written by Mr. Edward H. Smith. Few of us realize the extent of the stolen automobile traffic and how it reacts on the automobile theft insurance rates which we must pay for protection. For instance, during a prize fight in Madison Square Garden, New York City, not so long ago, there were some fifteen thousand enthusiasts inside that vast building, while outside, in all the surrounding and confluent streets, stood a thousand automobiles, attesting the prosperity of many who sweated and roared with the clamant mob at the arena. Policemen passed up and down the long, close-packed lines of cars; chauffeurs waited, dozing in their seats; the usual night-flow of pedestrians meandered by. Yet when the great gates of the hall were opened and the crowd came bellowing forth from its gory pleasures, forty-five automobiles were missing, stolen within three hours, under the noses of scores of watchers in the bright center of our greatest city! And that is but one instance of what takes place week in and week out in many of our large cities. It has remained for Mr. Smith, author of the article on burglars and burglar alarms which appears in the present issue, to investigate automobile thefts and to tell us, in his entertaining way, what this branch of criminology means in everyday affairs.

HOW fine engravings are made on the heads of pins and other work, known as microscopic test plates; how grain alcohol is medicated to foil the bootlegger, and the dangers lurking in wood alcohol and other ingredients employed in some of the present-day illicit liquor; how Germany is regaining valuable land within her own borders by means of ingenious machinery; how the motion picture folk reproduced with rare ingenuity the "Mayflower" for a photoplay depicting the perils and hardships encountered by the Pilgrims; how the all-devouring teredo has extended its field of operation to an alarming extent—these are but a few of the unusually interesting features of the forthcoming June number.

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SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

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Vol. 128, No. 5. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.

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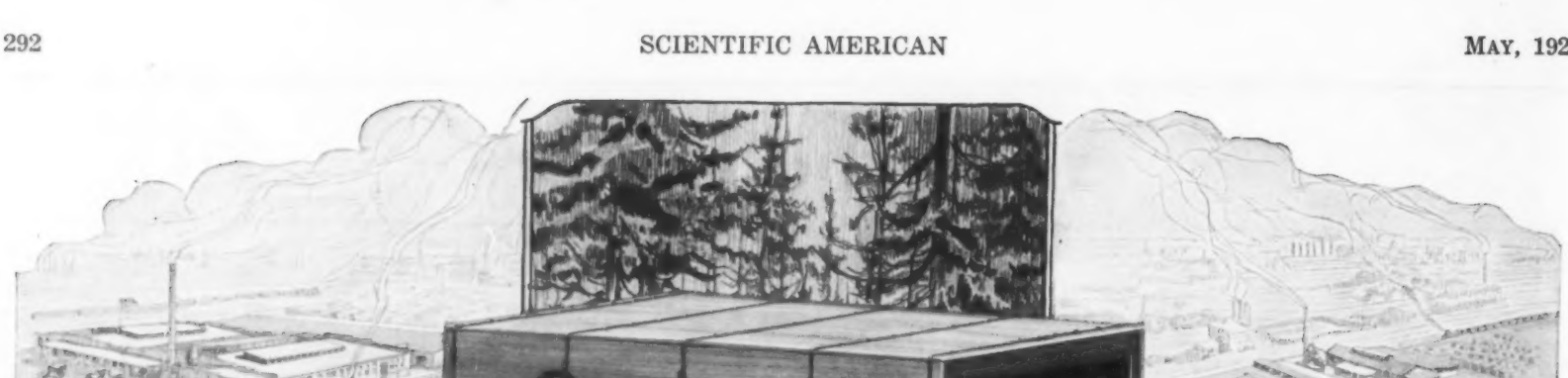

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A Condition—An Invitation—And a Fact

For years certain uneconomic conditions have prevailed in the manufacture and use of shipping containers.

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Each year industry loses hundreds of millions of dollars through the use of poor or improperly designed containers.

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We will be glad to send a competent box engineer to any shipper east of the Rocky Mountains, for the purpose of analyzing his shipping box requirements.

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You can then make a trial shipment in order to test thoroughly this specially designed box before you order. This engineering service is part of our policy. It places you under no obligation to us in any way.

A Fact

At the recommendation of one of our box engineers the Three-In-One Oil Company adopted the Pioneer (Wirebound) Box shown above and have used them for six years.

The advantages of this box are: its lightness and strength; it is practically theft-proof; quickly assembled; requires comparatively little storage space; can be quickly opened and unpacked; can be re-used.

The Pioneer is only one type of box. We make all kinds of wooden containers. Our advice is unprejudiced. If you are interested in this engineering service, please write us at our Chicago address.

A copy of G. B. C. Service—a bulletin of information on better boxing and crating—will be sent to anyone interested in this subject.

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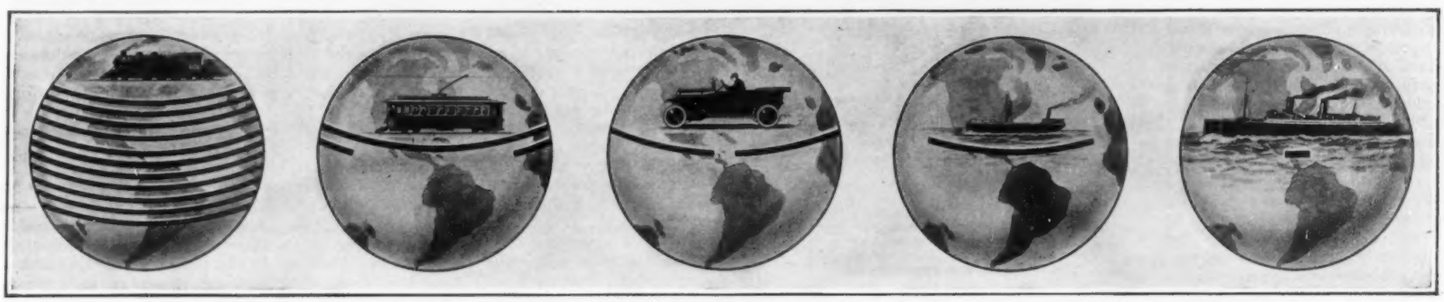
SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MAY, 1923



Comparison of the extent of five branches of modern American transportation. The lines are shown circled about the earth

Our Transportation Industry

ONE of the fundamental differences between the civilized community and the savage or barbarian one lies in the extent to which easy and rapid and cheap transportation is possible, alike of people and of goods. In any nation of today, prosperity depends mainly on the proper functioning of the transportation system, and the industry of transportation is necessarily one of the nation's largest. Nowhere is this more the case than in the United States, with its railroad and automobile supremacy.

Our drawings herewith attempt to show the relative importance of the several branches of the industry of moving people and things from place to place, in the United States. It is difficult to make a fair comparison here, and this is the reason why we have made two comparisons. Mileage of track systems is simple enough; but where shall we get a figure in the automotive field or in that of steam navigation to compare with this? Road mileage would not do it, because the larger proportion of our roads are unsuited to automobile traffic and are shunned by such traffic wherever possible. If, however, we attempt to dodge this difficulty by a comparison on the basis of capital invested, we find that the railroads have their money tied up partly in rolling stock and partly in tracks; while the automobile and the ship use rights-of-way on which money may be spent, but not by the industry itself, and not in a way calculated to get the best value or the best accounting.

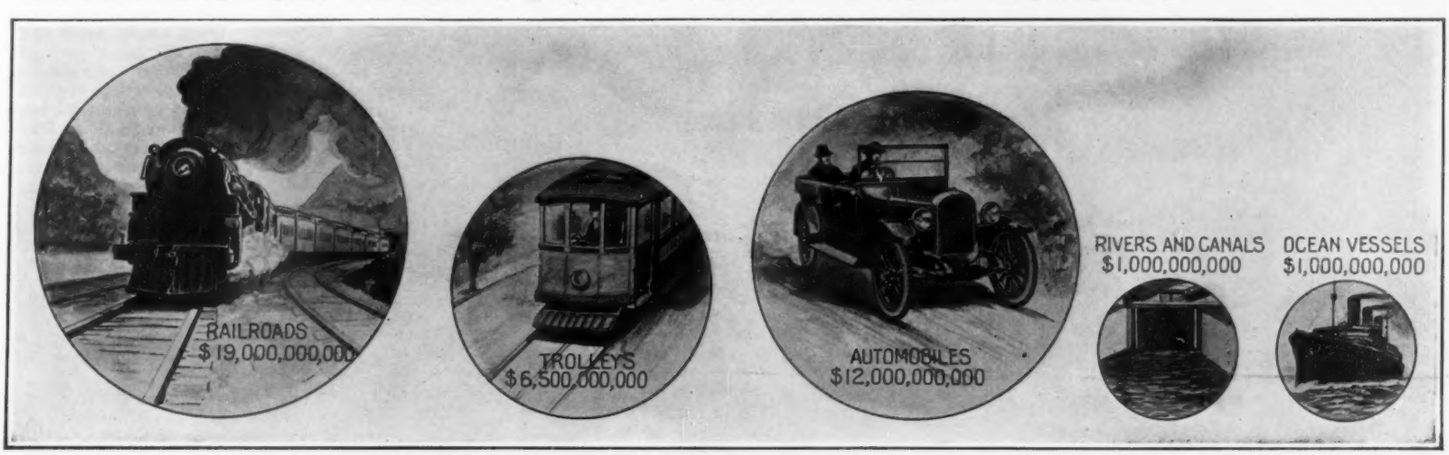
So it is clear that any comparison between these branches of transportation must be more or less forced, and that it means only what we may agree that it means. With this understood, we may glance at the manner of arriving at the figures used in the graphic statement of this page.

Mileage of railroad and trolley systems is something quite definite. Mileage for the automobile has been obtained by stringing all the country's cars and trucks out in single file. Such a line-up would be a very miscellaneous affair, with everything from the flivver to the giant truck. Remembering that the number of trucks is pretty small, in comparison with the number of cars; and that of the latter the ten-foot (from stem to stern) cheap car is preponderant, it seems hardly probable that the average car would require more than 12 feet to stand on. And if we string America's 10,300,000 motor vehicles out in line on this basis, they will occupy 23,400 miles of single track.

With the waterways we have two classifications. A river or canal has to be maintained to be fit for navigation; and we are told that we have 6,284 miles of such waterways on which money has been spent since 1913. It seems fair to assume that these are the live waterways, and that all others are dead. The ocean will not yield a mileage figure so easily, however, and here we must adopt the same procedure as with the automobile. For the 3700 ocean-going vessels calling at our ports, a fair average for the few passenger carriers would be about 500 feet, for the many freighters about 325, and for all combined about 350. This is, of course, nothing more than an intelligent guess; if we admit it, we may calculate that the ocean carriers engaged in traffic to and from the United States would fill a single-track waterway 250 miles long.

It will be noted that for purposes of mileage comparison our artist has made use of the globe, about which the mileage is distributed in bands representing 25,000 miles each.

On the other side of the picture, the cost of railroads and of trolley systems is again definite. When we attack the automobile, we are again baffled; the cars and trucks are authoritatively estimated to be worth about nine billions, but nobody knows what our roads are worth, or how many of them are suited to motor traffic. But since 1910 we have spent three billions on them. Perhaps we may assume that deterioration of roads on which money has been spent in this interval is offset by the use that our drivers get out of roads on which no money has been spent. If we make this assumption, we shall have a capitalization of twelve billions for the automotive industry. About $170,000,000 has been spent on rivers and canals since 1913; if we remember that expenditures for such things as this have increased in geometric ratio, a billion might cover the value of the waterways and the rather cheap vessels that utilize them. And at an estimate of $75 per ton—another intelligent guess—the 13,465,000 tons represented by the ocean-going ships stands for another billion. On this basis we have had our artist scale the accompanying drawings.



Relative investments in five branches of modern American transportation. The circles are drawn to relative scale

The Burglar and the Alarm

From the Simple Gong Alarm of Yesteryear to the Elaborate Electric Protective System of Today

By Edward H. Smith

IN THE summer of the eventful year 1865, the notable jewelry firm of Walker's, corner Suncourt and Cornhill Road, near London, was robbed of $30,000 in jewelry, plus some thousands in cash. It was not only a tremendous robbery for those days but it was an astonishing and, from our point of view, an historic affair, because it reveals the antiquity of some things we are used to consider ultra-modern—notably the unbeatable burglar alarm.

The year of grace 1865 is, as a matter of fact, modern enough in any general consideration of primitive alarms, such as collapsing partitions and that great and simple favorite, the set-gun, fixed to shoot down the intruding thief. But I am concerned here with alarms in a narrower sense and must leave such contraptions and their romantic history for future consideration. In the field of elaborate and costly installations against burglars, to which were brought what seemed the full bloom of human ingenuity—as in the case of the best protective systems today—Jeweler Walker's shop in Cornhill and the looting thereof stand out with the shine of the opening and telling engagement between the deviser and the thief.

Mr. Walker evidently understood that he was a shining mark and had done everything that a man of his times in London might have done to foil the intruders who threatened his prosperity and business survival. He had taken himself to the best safe builders in all England and equipped his place with a safe guaranteed to be proof against opening in less than eleven and one-half hours. (This was the day before nitro-glycerine or even gunpowder in the kit of the cracksman, of course.) But Walker had gone much further. He saw that burglars might enter either a lawyer's office above his shop or the establishment of a tailor adjoining. Consequently he caused the ceiling above him to be interlaid with a sheeting of iron, strongly bolted together and proof against any tools of the burglars of those days. He had similarly protected the sidewall between the tailor's shop and his own. Since the other walls faced the streets, where a constable patrolled all night, they were in no need of such fortification.

What the subscriber has in the way of equipment for exchanging signals with the protective "central" by a secret code. All openings and closings of premises are prearranged

At the subscriber's end

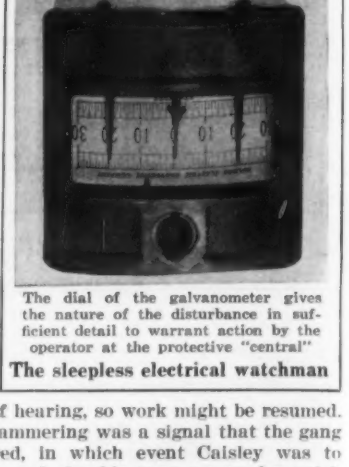
Yet Jeweler Walker had gone much further with his defenses. He had closed all his doors and windows with heavy iron shutters, in each of which was a series of peepholes, through which the constable or any passerby might look into his shop in passing, if curiosity or any disturbance drew his eyes to that direction. To facilitate this welcome spying, he allowed his lights to burn all night and equipped his shop with a set of mirrors which reflected the front of his fine safe to every one of the peeping-points. And last but most significant of all, he equipped his place with a complete system of bells and gongs. There were loud-voiced bells on every door or window, whose clangor must have summoned the constable from any part of his beat, had an entrance been forced. Again, Walker had the main entrance equipped with a tinkling bell for daytime use and further protected himself by means of another small bell in the interior of this shop, which connected with both entrances by a wire and sounded whenever anyone entered or left the shop. This was to serve as protection against the sudden entrance of holdup men or the quick and unnoticed flight of sneaks. Altogether an elaborate and ingenious equipment, the marvel of its time and, moreover, carefully concealed from the knowledge of London's teeming and ever-resourceful underworld.

But Mr. Walker was robbed. His beautiful protective and alarm system was beaten by methods which will ring in our ears with a very modern familiarity. "Velvet Ned" Caisley, so softly and appropriately named, committed the robbery and it is to him we are indebted for details.

Caisley and his underlings watched the shop, the jeweler, his employes and the workings of the mechanical equipment for nearly two months and made themselves all too thoroughly familiar with the habits of the men and the intricacies of the mechanism. Accordingly, after Jeweler Walker, his tailor neighbor and the barrister on the floor above had closed their doors one Saturday afternoon and gone their several ways in peace and security, Caisley inserted a master key into the lock of the door leading to the second floor stairway. The gang entered, and Caisley put the padlock back in place and snapped it, so that no passing officer might discover aught amiss.

The burglars went to the lawyer's rooms and tried to cut down through the ceiling to the premises of the jeweler. They soon struck the sheet-iron defenses and were foiled. But they knew how to get around the situation. Accordingly they went into another room of the lawyer's suite and quickly cut their way down into the tailor's shop whence they tried to bore into the jeweler's place through the side wall. But once more the iron balked them.

During this time Caisley, the master of the gang, had been lurking in the street—all Saturday night—watching the patrolling constable and notifying his lieutenants of the approach of the marching patrolman by a series of raps on the wall. Two raps told that the officer was approaching and notified the floor and wall cutters to desist. Three raps signified that the man was out of hearing, so work might be resumed. A quick drum of hammering was a signal that the gang had been discovered, in which event Caisley was to unlock the padlock and give his gang a way for quick egress.



The dial of the galvanometer gives the nature of the disturbance in sufficient detail to warrant action by the operator at the protective "central"

The sleepless electrical watchman

But this part of the code was never used. Instead, Caisley was summoned within the building toward dawn on Sunday and told that the case was hopeless on account of the iron sheetings. He smiled and took his men home. Toward dark of Sunday he again let his men into the building, followed them into the lawyer's suite and thence down, through the hole, into the tailor's shop. Here he directed his gang to cut through the floor into a low basement and thence up through the adjacent floor of the jeweler's place. The ingenious Mr. Walker had never dreamed of such a maneuver and the burglars were soon in his place, face to face with his formidable safe.

Caisley now made use of Walker's own alarm bells. He disconnected the wire which ran to the little bell in the interior of the shop near the safe, added some strong twine to it and ran it down into the basement, up through the tailor's and lawyer's rooms and thence to the roof, where he lay down behind a chimney and watched for the constable. He merely tugged at his string twice when the officer approached and thrice when he was again out of hearing.

With wedges and a giant jimmy, the other burglars in the Walker shop tore open the safe in two hours instead of eleven and a half. They took everything in sight, left the place, divided the spoil and scattered.

In this old tale from the police records of another generation, is summarized the full flower and complete defeat of the burglar alarm and protective systems devised in the older day, before the application of electricity. Whether electricity had in some instances been applied to alarm systems in England before the day of Jeweler Walker and Velvet Ned, I do not know. But in America the electric burglar alarm had long been in existence even if not in general use.

The sensitive galvanometer, interior of instrument shown at top of page, indicates when the closed circuit is either cut or bridged, and gives warning also of fire or water leakage

The galvanometer: an electrical nerve center

The first practicable electric alarm, on which the most extensive modern developments of the system are based, was patented in this country in 1852 by Charles Pope. This inventor is said to have sold his rights to Edwin Holmes in Boston in 1857, and Holmes certainly brought the idea to New York in 1858, at which time his companies were endeavoring to introduce electric alarms in both cities.

It is interesting to note that the late P. T. Barnum, that pioneer in many things, was an early user of such an alarm, for there is extant a letter of his under date of July 2, 1866, wherein he writes that he has had the system installed in his house in Bridgeport for three years, that three attempts at burglary had been made in that period and that all would have succeeded save for the alarm. He comments that he would not be without it for a month for a thousand dollars.

Somewhat later the Corn Exchange Bank, Hanover National Bank and the jewelers, Tiffany and Starr, installed electric alarms and have, as the manufacturer informs us, used the service for more than fifty years.

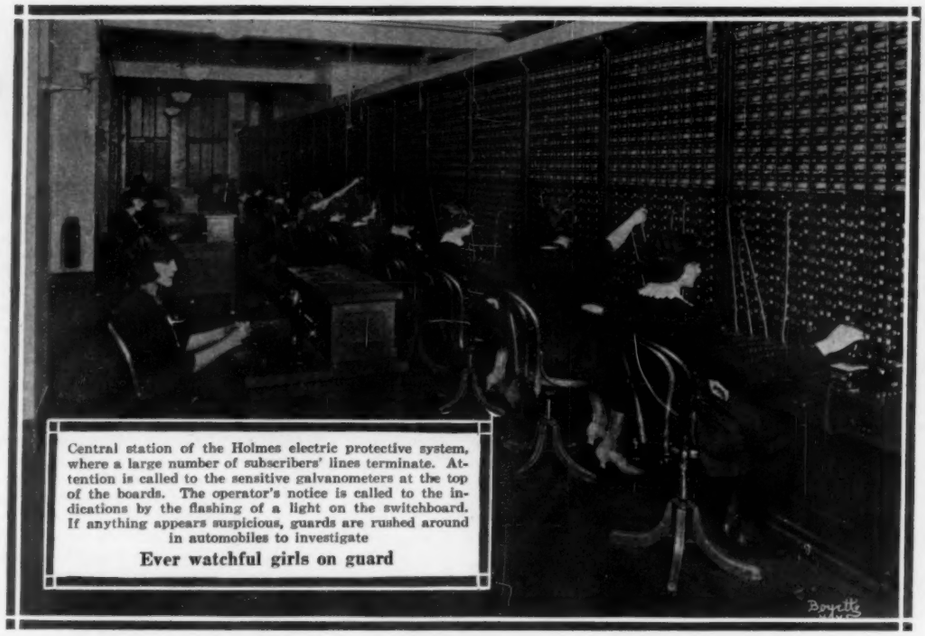
It seems probable, therefore, that the electric burglar

Valuable merchandise, records, etc., can be effectually safeguarded by special enclosures surrounded by a network of wires. The ceiling and the floor should also be guarded to make the installation burglar-proof

When fine wires are more effective than armor plate

alarm was a partly recognized protective device in America somewhat earlier than in other countries. The credit for the invention of a practical type belongs in this country. As always happens, however, our bankers and business men as a class were slow in adopting this new marvel. The largest and most advanced firms had it installed, but the rest hung back and followed the usual procedure of letting themselves be forced to progressiveness by misfortune. They locked the door of the empty stable and many still hold to this vain practice. After the robbery they install better safes, burglar alarms and the like. Thus, even twenty-five years after the introduction of the first electric alarms, there were only a few hundred in use in our great cities and a few dozens in other parts of the country.

Many imitators of the original inventors sprang up in all parts of the nation. Again, many local electricians made experiments of their own and evolved types of alarms of varying degrees of effectiveness.



Central station of the Holmes electric protective system, where a large number of subscribers' lines terminate. Attention is called to the sensitive galvanometers at the top of the boards. The operator's notice is called to the indications by the flashing of a light on the switchboard. If anything appears suspicious, guards are rushed around in automobiles to investigate

Ever watchful girls on guard

A number of banks allowed local inventors to wire their premises with a system connecting a gong, usually outside the bank, above the door, with a plug or plunger which came up through the floor of the bank, in front of the safe or vault and rising perhaps an inch over the floor. In the day-time this plunger was held down by a trigger arrangement under the floor, but when the bank was closed for the night the trigger was released and a chair set in front of the vault in such position that one of its legs stood on the plunger, holding it down by the chair's weight. If, during the night, the chair was moved, the plunger would fly up, setting off the electric alarm.

This was effective, of course, just as long as the burglars were in ignorance of its existence or mechanism, which was not for many days. An alarm on the outside of a bank is always conspicuous, which is one of the intentions of those who employ such devices, the theory being that the burglar will see that the bank is safeguarded and pass on. And in a good many instances this theory justifies itself. It all depends on the burglar. If he is the casual yegg, who does not know his craft over-well and follows the line of least resistance, he "passes up" banks with alarms installed. But if he belongs to the better rank of bank men, he knows how to disconnect many of these external alarms. Such men soon found out about the rising peg and the chair in front of bank vaults, with the result that bankers who had slept unworried woke to find their vaults open and the cash gone, while the faithless plunger remained inactive under the weight of a few bricks.

In an earlier chapter I have discussed the rise of nocturnal bank burglary, which played an important part in the development of alarms. Burglars used their talents against banks in this country as early as the beginning of the nineteenth century. But nocturnal attack did not become a favorite method of criminals until the introduction of explosives for this purpose in Civil War days. Gunpowder was employed by these earlier safe crackers. Later on came dynamite and nitroglycerine. Then came the heyday of the yeggman and the almost nightly explosion of safes in banks, post offices, mercantile establishments and elsewhere.

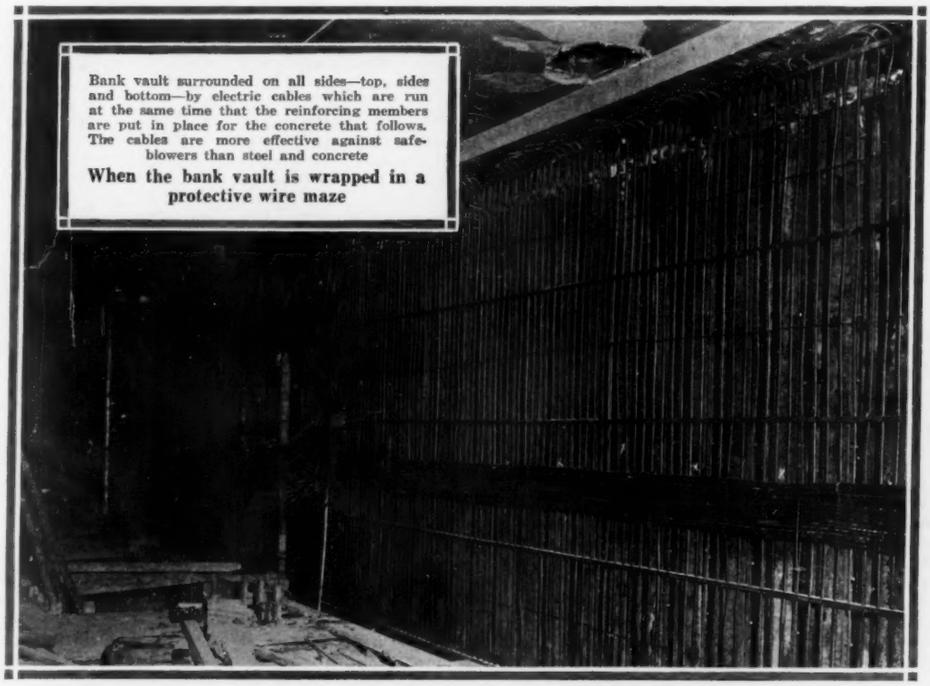
Naturally, this development from the criminal world stimulated not only the adoption of burglar alarms by bankers and others, but the invention, manufacture and development of such devices—of many types and styles. As a matter of fact, the work of yeggmen caused the general adoption of the alarm for banks in one section of the country after the other. About 1905, for instance, nocturnal bank burglars were in their ascendancy in the Middle West, in such states as Iowa, Missouri, Kansas, Nebraska and Oklahoma. A little earlier similar bands of nitro-glycerine burglars had been ravishing the South Atlantic States, as well as West Virginia, Maryland and Delaware. As these robbers progressed through any given region they were followed by the salesmen of safes, insurance and burglar alarms. These men covered every bank within 50 or 75 miles of the one that had been robbed, and most bankers were at last persuaded to adopt precautious measures.

One general type of alarm was sold at this period to half the rural or suburban banks in the Middle West. Its main feature was the familiar gong on the outside of the building. The best had complete sheet steel lining for the inside of the vault, connected with the gong by electric wires. To cut, break or tamper with this lining was to set off the alarm. Neither could the burglar adopt the simple method of cutting the wires, for this broke the circuit and likewise sent the gong into hysterical vibrations. The better class of burglars knew, of course, how to muffle many such alarms before entering the bank, yet this system of protection proved decidedly successful and is still in very general use. The reasons for its survival in spite of apparent weakness may be interesting.

Burglars of even average skill did not always avoid banks equipped with such alarms because of this invention, a fact proved by the instances in which the devices were easily and simply disposed of. But they did pass them by for better reasons, founded on caution. There were still plenty of banks without alarms. To the burglar's mind here was a great and grave distinction—that between the progressive banker and the backward or careless one. The yeggs found that alarms had been installed by bankers in the more prosperous and advanced towns, where there was likely to be better policing and a better public spirit. Such towns were dangerous to the robber. Moreover, the man who would spend money on an alarm usually also had a better safe and might have concealed some other protective device which the robber could not divine. So the yegg went after the banks without alarms. A negative triumph, shall we say?

But the reasonably effective burglar alarms were hardly well installed when we came again upon one of those endless shifts of scene and technique which characterize the whole struggle between the law and the criminal, and especially that between the felon and the inventor. The very large numbers of nocturnal bank burglaries had brought in the alarm, but they had also put into many banks in all parts of the country ever better and better safes, until the point was reached where most exposed banks had equipped themselves with heavy modern safes of the screwdoor type. The average yeggman was temporarily put out of the running and turned to other and radically different methods.

The automobile had now come into general use and the streets of the cities began to be more and more crowded with cars. Many yeggs turned bandits, came to the cities from their usual hunting grounds in the country and began holding up urban banks at high noon and escaping in motor cars through the welter of city traffic. This recrudescence to the methods of such distant and primitive robbers as the James boys, began about 15 years ago and has constantly grown in volume. To meet the peril, various bandit alarm systems have been developed for use against the daylight robbers.



Bank vault surrounded on all sides—top, sides and bottom—by electric cables which are run at the same time that the reinforcing members are put in place for the concrete that follows. The cables are more effective against safe-blowers than steel and concrete

When the bank vault is wrapped in a protective wire maze

The first of these was simply an electric push button connected with a gong on the outside of the bank. When the bandit entered, the teller made a quick reach for the concealed button and off went the alarm—unless, of course, the bandit was quicker on his trigger than the teller on his button. Today all such alarms are considered not only of doubtful value but potential of murder. They are open invitations to shooting on the part of the bandit, since, when he sees a gong affixed to the front of a bank he is about to rob, he enters with the full determination to shoot

(Continued on page 346)

Tutenkhamon's Tomb

What This Latest Archaeological Discovery Means in the Light of Earlier Explorations

By Dr. T. George Allen

Secretary, Haskell Oriental Museum and the Oriental Institute, University of Chicago

HUMAN nature retains its fertile gift of curiosity. The Earl of Carnarvon's interest in Egypt's past led to this winter's marvelous discoveries; but the spell of ancient wonders was strong already 4000 years ago. The mighty pyramids of Gizeh were as remote in time to the Egyptians of the Middle Kingdom as the Magna Carta is to us. Even then those tombs had long since been plundered, and a song tells us how keenly the realization of their colossal futility was felt by the skeptics of 2100 B. C. About the same interval separated a district ruler named Khnumhotep at Beni-hasan from some late Empire visitors to his tomb. Finding the name of Khufu, builder of the Great Pyramid, involved in a town name occurring in the wall inscriptions, these careless archaeologists scrawled upon Khnumhotep's wall their admiration of the "temple of Khufu." This same tomb has been embellished in the three thousand years since those visits by the autographs of a mighty army of tourists, native, classical, and modern.

In the seventh century B. C. begins an age sometimes called the Restoration, because it was so eager to revive the good old days. A high official of this period, a certain Ibi of Thebes, succeeded in discovering at Deir el-Gabrawi the tomb of a noble of the same name who had lived during the Old Kingdom, almost two thousand years before, and had its scenes and inscriptions copied in large part in his own. The Theban prince Mentemhet, who lived just before Ibi's time, copied some of his tomb decorations from the neighboring Empire temple of Deir el-Bahri, built by Queen Hatshepsut about 1500 B. C. More familiar are the numerous remarks which classical visitors have recorded both about and upon Egyptian monuments. The once vocal "Colossus of Memnon" at Thebes bears especially numerous souvenirs in Latin and Greek carved by tourists of the Roman imperial age, among whom the most distinguished was the emperor Hadrian. Accounts of various sites are found too in the works of medieval Arabic authors. The caliph el-Mamun, who ruled the Moslem world in 813-833, was more "practical" in his attentions to the Great Pyramid. His workmen did succeed in breaking in and rediscovering its passages; but the treasure they anticipated was not there, and el-Mamun himself had to supply some to appease them.

Napoleon, on his ill-fated expedition which occupied Egypt in 1798-1801, included numerous savants. By his orders was published the huge *Description de l'Egypte* which forms the official record of their labors. This led to a wide-spread modern revival of interest in the ancient civilization. One of the French finds (afterwards taken by the British) was the famous Rosetta Stone, which played a part in the decipherment of the ancient language. Its fundamental principles were finally determined by the Frenchman Champollion in 1822, after both he and others had spent long years in study with only partial success. Knowledge of the language, in the details of which continuous progress has since been made, has been of infinite importance in acquainting the modern world with Egyptian religion, science, literature, and art as well as history.

A few hardy European explorers had visited Egypt in the seventeenth and eighteenth centuries. Their number was vastly increased in the nineteenth, and many were the antiquities carried away in its early decades. There was no governmental Egyptian museum until 1857. Then, under the khedive Said, the museum of Bulak (now at Cairo) was founded and to the French excavator Mariette was assigned its organization and maintenance. To provide its collections, excavations on a large scale were now begun under official auspices, so that Mariette had as many as 37 scattered sites under investigation at once. He is to be remembered especially for making accessible important temples at Abydos, Dendera, Edfu, and Thebes, as well as for his earlier success in 1851 in finding the great Serapeum of Memphis.

Just at the close of Mariette's life, in the winter of 1880-81, his workmen opened the pyramid of King Pepi I at Sakkara and discovered that the walls of its chambers were covered with inscriptions. Sir Gaston Maspero, continuing his predecessor's work there, found four more similarly inscribed royal tombs of the same Old Kingdom period. The so-called Pyramid Texts, thus revealed, constitute the earliest and most fundamental contribution to our knowledge of Egyptian religion. Some of their incantations, evidently long handed down, reflect conditions even before the union of Egypt into one nation.

Maspero was responsible at the same time for another outstanding achievement. Since 1871 bits of royal tomb equipment had been finding their way to Europe. In 1881 Maspero tracked down the modern robbers. One of them finally disclosed, beside the Theban cliffs, the well concealed mouth of a pit that led via a long subterranean passage to an ancient hiding place crammed with coffins of Egyptian royalty. The weak kings of the XXI. Dynasty, unable to protect the bodies of their imperial predecessors in their original tombs, had transferred them hither for safety. Thus came again to light in person the greatest pharaohs of the Empire (XVIII.-XX. Dynasty).

Excavation, however, was still on an uncertain basis. Illicit digging by natives has always been a problem. But even the government's own work was incompletely recorded and still less completely published. Moreover, permits came to be granted not only to scientific organizations but to many untrained individuals who thought only of the market for antiquities. The Egypt Exploration Fund (now Society), founded in London in 1882, and Professor W. M. Flinders Petrie, who later organized the Egyptian Research Account and British School of Archaeology in Egypt, pioneered in better methods of record and publication. Their respective series of annual memoirs continue to be of first-rate importance in the comparative study of new finds or old. Petrie's work for the Fund at Abydos recovered the history of the I. and II. Dynasties, which had until then been a myth.

Meantime, in 1887, came a find epoch-making in our knowledge of the history of the Empire. At the site we call Tell el-Amarna villagers chanced upon a room which had evidently contained files of the imperial State Department. The correspondence they found, written in Babylonian cuneiform (the then current language of diplomacy) on clay tablets, included letters of King Amenhotep III and his son Ikhnaton both to and from numerous rulers and vassals in Western Asia. But the clandestine distribution and sale of these tablets, involving their being sacked and hauled around on donkey-back, destroyed some and seriously damaged many others. Tell el-Amarna has since yielded further light on the distinctive history and art of Ikhnaton's period. For its tombs have been investigated both by French scholars and (more accurately) by the Egypt Exploration Society; and excavation among its ruined temples, palaces, and homes has been carried on by Petrie, by the Deutsche Orient-Gesellschaft, and (since the European war) by the English society again.

The Deutsche Orient-Gesellschaft, established in 1898, has kept model records of its various excavations, and has published results with admirable promptness. In fact, scientific methods have been much more usual since the opening of the twentieth century. The Egyptian Service des Antiquités began in 1899 to publish "Annales" recording in some form at least, the work in progress; and the first volume of an official scientific catalog of the Cairo Museum appeared in 1901. America has in the last two decades played an important part in Egyptian excavations. Professor Reisner has been in the field almost continuously, first for the University of California, since then for Harvard University and the Museum of Fine Arts at Boston. From his work in Upper Nubia he has been able to reconstruct the history of Egyptian conquest in that far southern region, as well as of the later Ethiopian kings and the decay of their borrowed civilization. Mr. Lythgoe and his able associates, Messrs. Mace, Winlock, and others, by their work for the Metropolitan Museum of Art in New York, are not only contributing new data on history and art but have equipped their institution with the best documented and best displayed Egyptian collection in this country. Another American, the late Theodore M. Davis of Newport, financed excavations at Thebes which discovered several hitherto unknown royal tombs. The furniture of Yuya and Tuyu, the parents of Queen Tiy, grandparents of Ikhnaton, and great-grandparents of Tutenkhamon's wife, found in one of these, was considered remarkable until the equipment of Tutenkhamon himself turned up.

The Earl of Carnarvon, with Howard Carter as his field director, first undertook systematic clearances in western Thebes in the spring of 1907. The territory then granted him was not considered very propitious. Yet in the next few years he discovered not only various archaeologically interesting private tombs but also the valley temple at the foot of the causeway that led to Queen Hatshepsut's splendid terraced sanctuary of Deir el-Bahri. In 1914, working in the hills behind Drah Abu'l-Negga, the plundered tomb of King Amenhotep I was found. This had been known heretofore only from court records of the XX. Dynasty, preserved in the Papyrus Abbott, which claim that at that time "it was found uninjured by the inspectors."

The hunt for Tutenkhamon's tomb is said to have begun in 1915. Meantime, almost inaccessible in the hills well back of Biban el-Muluk, there was discovered during the winter of 1916-17 an unfinished tomb which had been intended for the "king's wife" Hatshepsut. But when she became a pharaoh in her own right she had had a new tomb (discovered by Carter in 1903 while in the service of Mr. Davis) prepared in the kings' own valley. Lord Carnarvon's activities in the latter region met for years with very indifferent luck until their recent culmination in a success beyond all anticipation.

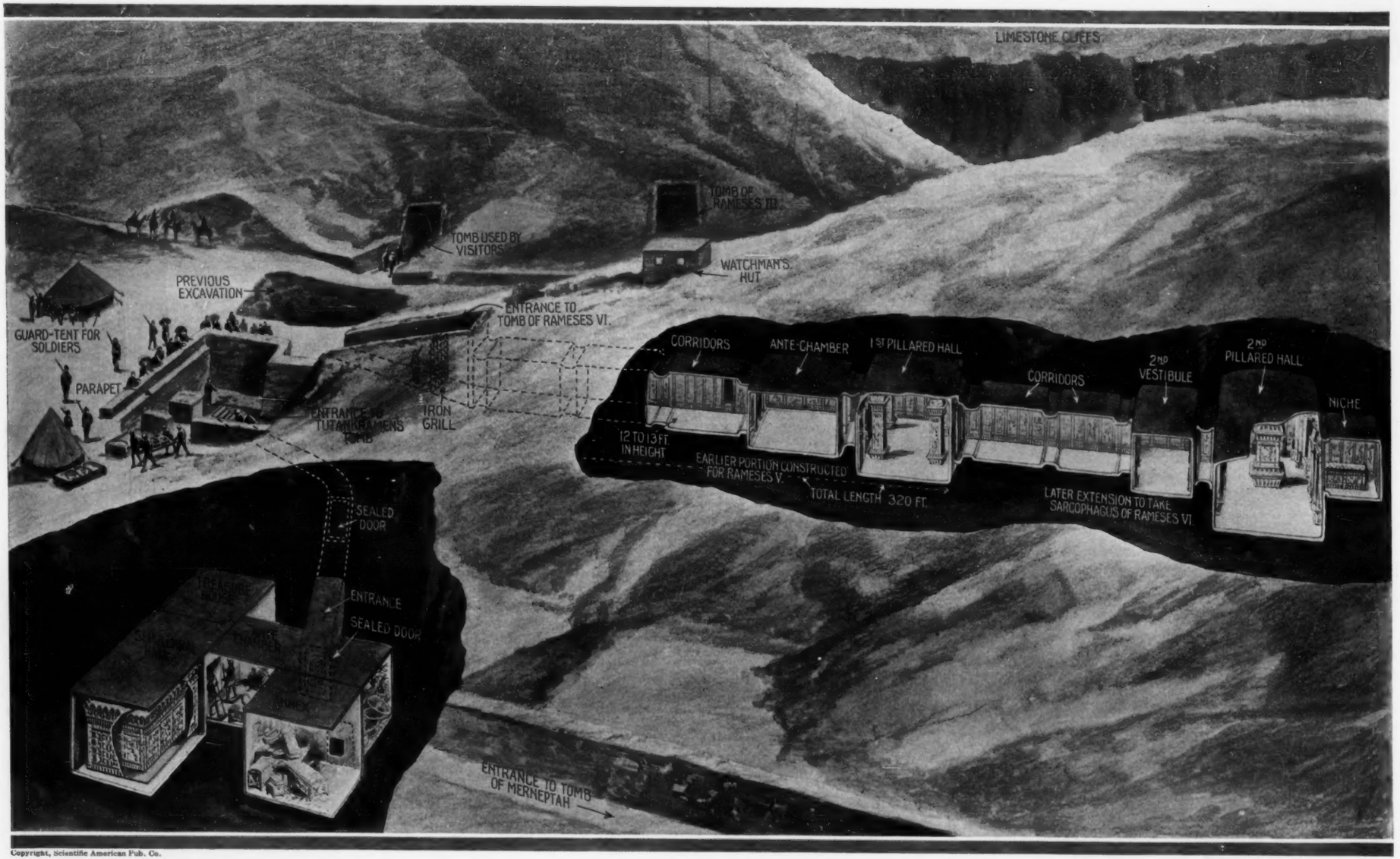
As King Tutenkhamon's name is appearing in various spellings, it should be explained that the ancient Egyptian language writes only consonants. The Egyptologist, thus left in the lurch, can transliterate only *T w t* (image)—*ꜥ n ḫ* (living)—, *m n* (of Amon). The vowels with which the Egyptians clothed such skeletons can be only approximately inferred. Since our transcription cannot avoid some arbitrariness, the writer has preferred to follow Breasted's "Ancient Records of Egypt," the spellings in which are gradually becoming standard.

Finds made in the past have determined Tutenkhamon's position in history. The monotheist dreamer Amenhotep IV, changing his name to Ikhnaton, had broken with the powerful priestly group, done away with its inherited privileges and estates, destroyed even the names of the old deities wherever accessible, and moved his capital from Thebes, defiled by memories of Amon, to a new site, the present Tell el-Amarna. Here, in honor of his sole god Aton, the beneficent sun disk, he had caused a new city to arise, unfettered by traditions of the past. The free sweep of his religion, mirroring a world vista inspired by earlier imperial conquests that reached from the Fourth Cataract of the Nile in Africa to the Euphrates in Asia, was paralleled by a new freedom in the art he sponsored. But against the enmity of the priesthoods he had outraged and the deep-rooted traditions he had violated, no son was granted to uphold his faith. After Ikhnaton's death about 1358 B. C. one youthful son-in-law, Sakere, appears momentarily as pharaoh, but is followed almost immediately by a second.

Tutenkhaton, "living image of Aton," as the new king

(Continued on page 348)

THE purpose of the accompanying article is to place the Tutenkhamon discovery among the long chain of other archaeological discoveries which have enabled us to reconstruct the history, customs, religion and other phases of ancient Egypt. We asked Dr. T. George Allen, Secretary of the Haskell Oriental Museum and the Oriental Institute, University of Chicago, to outline Egyptian archaeology, and to furnish us with the proper background for a true appraisal of the present marvelous discovery. This he has done, and done well.—THE EDITOR.



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FROM numerous authentic sources of information, together with the highly appreciated co-operation of several Egyptologists, our artist has obtained his data for this interesting drawing. To our knowledge, this is the first presentation of the Tut-ankh-Amen tomb in its entirety.

The discovery of the Royal Tomb at Thebes is unquestionably the most interesting "find" that has ever been made in Egypt. Never before in the history of archæological exploration has an unrifled royal tomb been found; it may be said, therefore, that every feature of this wonderful discovery is new. From the other royal sepulchers in the Valley of the Tombs of the Kings, much was already known about the funeral paraphernalia of a Pharaoh; but every tomb that had been found up to November of last year had been plundered in ancient times. All the objects brought to light from these rifled sepulchers had been stripped of their gold and other metal coverings, and they had been wilfully smashed to pieces and their fragments scattered about the floors. The chief value, therefore, of Lord Carnarvon's and Mr. Howard Carter's discovery is that it reveals to us a king's tomb with all its magnificent furniture complete and in position, arranged just as the priests had left it when they sealed up the Pharaoh's sepulcher. That, to the archæologist, is the most important fact revealed by the "find."

In our drawing we have shown the limestone cliffs of the Valley of the Tombs of the Kings, the openings to previously explored tombs and a sectional view of the tombs of Rameses V. and VI., together with the arrangement of the tomb of Tut-ankh-Amen. It was the discovery of the steps cut in rock which first led to the finding of the tomb. At the bottom of these steps is a sealed door through which Lord Carnarvon and Mr. Howard Carter obtained their first glimpses of the remarkable treasures in the first or ante-chamber. The ante-chamber, it will be noted, contained the couches and the guardian statues. From the ante-chamber there are two doors, one leading into the "Hall of Gold" or shrine room, and the other into the second chamber which has not yet been cleared. The shrine nearly fills the sepulchral hall, and is believed to comprise a number of walls, one within the other, with the sarcophagus of Tut-ankh-Amen in the innermost canopy. We are indebted to the New York *Times* for a diagram of the floor plan of the tomb, which was drawn from a description sent by radio from the expedition in Egypt.

GENERAL ARRANGEMENT OF THE TOMB OF TUT-ANKH-AMEN AND ITS LOCATION IN THE VALLEY OF THE TOMBS OF THE KINGS

Taking Nitrogen from the Air

A Wonderfully Fascinating and Invaluable Achievement in Chemical and Electrical Progress

By Littell McClung

THE fixation of atmospheric nitrogen is fascinating to the average intelligent person just as it is alluring to the scientist, hydraulic engineer, electrician and the higher type of mechanician.

Nitrogen in its free state—as an element of the atmosphere—is free, just as is water from the mountains or heat from the sun. But while it is free and boundless—vital every minute to all animal life and a continuous necessity in plant growth, transforming it from its free state into usable, fixed form has been a major problem of science. It has been a challenging endeavor to the keenest chemical minds on two continents ever since it was discovered that nitrogen could be "fixed" by man for his uses, just as growing plants, through some alchemy of their root fibers, extract from the air in the soil some of its nitrogen for their strength and growth.

Sixteen-hundred pound ingots of cyanamid or lime nitrogen held in storage

That which is subtle and variable, that which exhibits its force and power in contradictory phases, ever appeals to the imagination. And so it is with nitrogen, the dynamic, double-natured elixir. Although colorless, it may exhibit its latent potency in the flaming hue of a dye. It is tasteless, yet there would be no flavor in foods without it. It is odorless, yet the sense of smell would hardly be a sense if not touched by it. And what fruitful smiles radiate from it simultaneously with hideous and ironic grins! In poison gas it blinds the eyes and withers the lungs; whereas in synthetic anesthetics and lotions it prevents pain and soothes the wound. It expresses an exquisite phase of itself in some of the rarest perfumes, and in its free state is almost four-fifths of the purest air. As a gas bomb it blasts vegetation; as nitrate of soda it hastens plant growth and gives life and vigor to root, stalk, branch and fruit.

Therefore, it is little wonder that nitrogen charms and challenges. Nitrogen the fickle and fascinating; nitrogen the invaluable, is wealth in its finest forms—the immaculate whiteness of cotton, the gold in the wheat, and the blush on the apple.

Nitrogen is the most valuable of the elements—none other can produce the usable wealth that it is capable of creating. It will "make" cotton just as it will corn and wheat, peaches and potatoes. Without it there would be no cotton, no grains, no fruits and vegetables, no clovers nor flowers, for it is indispensable to plant life.

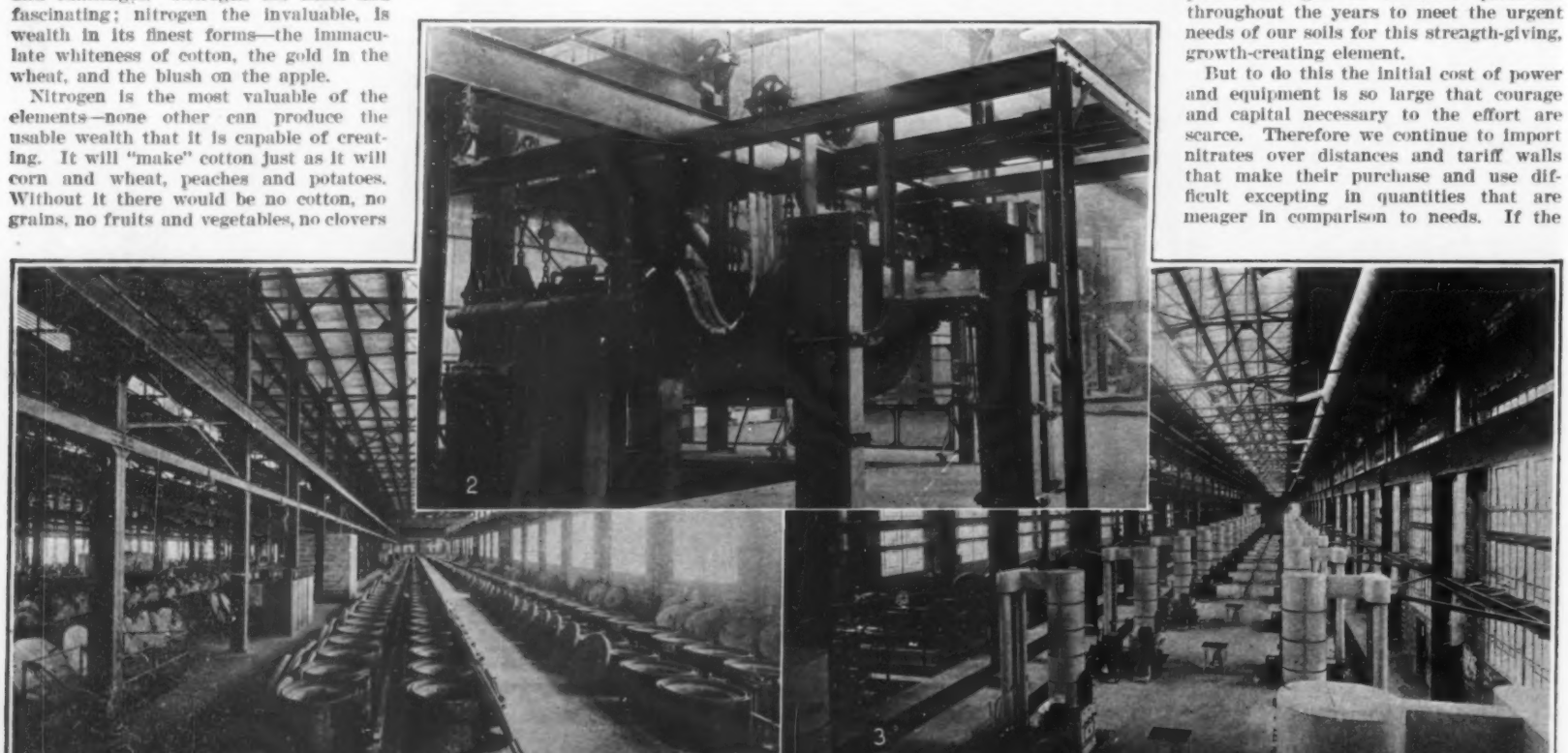
The soils of our country, so generously and uniformly endowed by Nature with potash, are lacking in nitrogen—sadly lacking. There are literally no confines to the nitrogen needs of America's farmlands and her major crops, and no man can mark any boundaries to the commercial possibilities of the fixation of atmospheric nitrogen. It is an industry in which there is no "saturation point." The greater the use of nitrogen under crops and in soils, the larger will become both need and demand—and the ability to buy. With sufficient nitrogen, what is now grown on five acres can be produced on one; and then what is produced on one acre can be harvested off half an acre. The crop-growing potentialities of a given area are unknown. They have never been reached on any plot nor by any crop; and probably never will be. However, three bales of cotton or two hundred and thirty bushels of corn to the acre—both accomplished—give some conception of the boundless possibilities of wealth creation on small areas.

This season the world—for the first time—is threatened with an actual shortage of cotton. The immediate cause of this is the comparative smallness of the crops since 1914, due to farm labor shortage and the spread of boll weevil infestation. But at bottom the cause is lack of cheap nitrogen in abundance. With plenty of nitrates at low cost, the southern farm labor scarcity could be overcome by acreage reduction and more intensive cultivation. These, in themselves, would tend greatly to reduce boll weevil damage.

And yet with nitrogen so inadequately applied to the crops, the chemist and the electrical engineer have solved the problem of the fixation of free nitrogen in the air. The United States has the largest plant in the world for this remarkable, yet practical, purpose. But, however paradoxical it may seem, virtually nothing is being done in the United States to take from the air an infinitesimal part of its nitrogen and give this cheaply and plentifully to our soils and our crops. The reason for this inactivity—so costly to farmers and consumers alike—is that in some lines of commerce we move along the grooves of custom and habit; the familiar, expensive methods and practices.

For many years we have been buying nitrate of soda from Chile, where nitrates are dug from the earth just as is iron ore in Michigan, coal in West Virginia and Alabama, sulfur in Louisiana, or phosphate in Florida and Tennessee. Our expensive, hand-made methods of fertilizer manufacturing and distribution have been based on importations of Chilean nitrates, with some additions from the by-products coke ovens. And yet there is more nitrogen in the air over any American county than will ever be mined in Chile. And there is more above any farm than in all the by-products ovens of the world. And we can secure this atmospheric nitrogen in limitless quantities throughout the years to meet the urgent needs of our soils for this strength-giving, growth-creating element.

But to do this the initial cost of power and equipment is so large that courage and capital necessary to the effort are scarce. Therefore we continue to import nitrates over distances and tariff walls that make their purchase and use difficult excepting in quantities that are meager in comparison to needs. If the



Left: Charging room of the carbide furnaces, showing cylindrical silos from which the mixture of coke and lime is drawn off into the electric furnaces for making carbide. *Center:* Huge electrodes being lowered into the electric furnace to combine, at a very high temperature, the coke and lime into carbide. *Right:* The scrubbing towers in which the air is chemically relieved of its carbon dioxide and is thus purified

Three interesting steps in the process of extracting nitrogen from the air and fixing it

nitrogen applied to the present crop were multiplied five times, the crop would actually need still more of this stimulant to growth and fruitage.

There are several methods and processes for the fixation of atmospheric nitrogen. In this country only one of these has been proved to be commercially practicable. This is the cyanamid process. There has been and may continue to be contention as to cost, but the method itself has been a success beyond all question. During a time long enough to demonstrate thoroughly its practical value, it produced large quantities of nitrogenous products, chiefly ammonium nitrate. In fact, there are more than three million pounds of the white crystals of ammonium nitrate stored at the source of their manufacture. This product remains unsold and unused because the status of the giant plant that produced it remains in doubt—is still undecided by Congress. The corporation that had a part in the operation of this Government-owned plant, states definitely that one year's continuous operation would have saved, in the cost of nitrogen and its products, the entire vast cost of the plant—$70,000,000.

On a large scale, the cyanamid process is one of the most beautiful synchronizations of power, machinery and materials ever accomplished. The materials used are coke, limestone and air. All three, as we know, exist and are obtainable in abundance and at small cost. The Government placed its great cyanamid plant on the Tennessee River in a limestone and coal region.

The process starts when crushed limestone is brought in on freight cars and discharged into huge concrete storage bins. From these bins it is fed out automatically into rotary lime kilns. There are seven of these kilns and each is eight feet in diameter by one hundred and twenty-five feet in length. The heating agent of these mammoth rotating kilns is pulverized coal. Lime, of course, is discharged from the kilns after the heating, and it passes through coolers to the Raw Material Building.

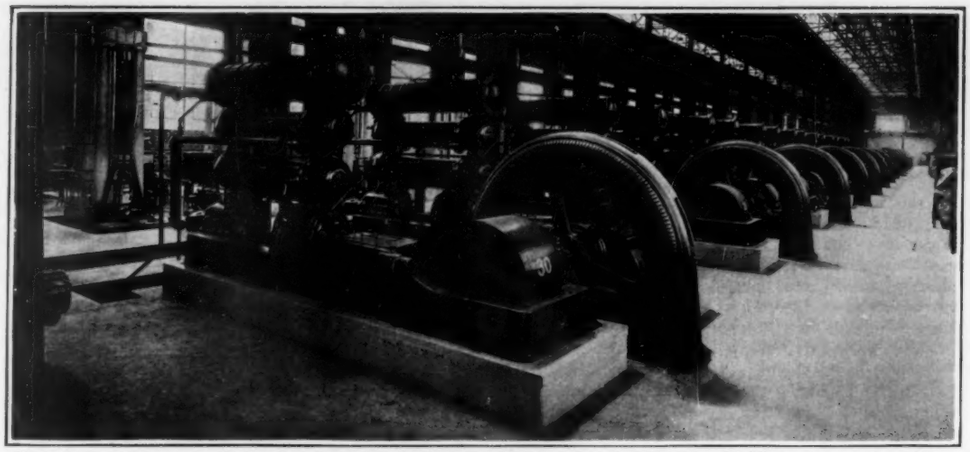
Meanwhile coke, the other basic material, is likewise brought in on cars. It passes through crushers and driers and meets its future partner, lime, in the Raw Material Building.

Put in proper physical condition for future treatment we have here two ordinary and plentiful substances—lime and crushed coke. Both materials move through weighing and measuring apparatus in desired quantities preparatory to their union into carbide. Then they pass into twelve cylindrical silos. Now the purely physical mixture of lime and coke is ready to be drawn off to the electric furnaces for swift chemical union under the influence of tremendous heat.

Here great power is needed because the combining of the two takes place at extremely high temperature. To supply this energy there are steam turbines generating upwards of one hundred thousand horse-power. However, in time, the furnaces and the entire nitrate plant will be operated by hydro-power from the great river nearby.

In the process as it exists, there are three electrodes to each of the twelve carbide furnaces. Each electrode is six feet, five inches long. These electrodes swing into the furnaces and bring the temperature of the basic materials—lime and coke—up to the fusing point. The result is white-hot calcium carbide.

This is drawn off in somewhat the same manner, as at blast furnaces or in foundry practice. However, it is drawn into electrically-operated chill cars where it solidifies. Then it passes into the Carbide Mill Room where it is crushed and ground to the fineness of flour. At this stage it is ready to receive the nitrogen, and nitrogen gas is on the way to join it.



Electrically-driven compressors in which the air, through three stages, is put into a highly compressed condition

This nitrogen is extracted from the air in the Liquid Air Building than which there is no more beautiful manufactory in the world. Incidentally, it is the largest liquid air plant in existence. It demonstrates the Claude process of liquefaction and fractional distillation. The air used must be as free as possible from foreign matter. And so there are two openings to the intake pipe more than a thousand feet north and south of the building. If the wind is blowing from the north, carrying dust-particles from that direction, then the air is taken in through the south opening. On the other hand, a southern wind calls for the use of the north opening.

Coming into the building the air passes through high scrubbing towers where it is chemically relieved of its carbon dioxide. From these towers it moves on in pipes to electrically-driven, high-pressure compressors. There are thirty of these and each carries the air through three stages of compression. In the third compression the air is discharged at a pressure of five hundred pounds to the square inch.

In this highly compressed state the air passes from the compressors into the thirty giant liquefaction columns. In its passage it is given work to do—some effort to make—and thus releasing energy in its compressed state, its temperature is reduced with amazing rapidity. It drops to a coldness unknown to personal human experience. This marvelously swift release of energy (heat) in its compressed condition reduces the air to liquid form and brings separation of its nitrogen and oxygen; nitrogen liquefying at approximately minus one hundred and eighty degrees centigrade, and oxygen becoming liquid at ten degrees centigrade lower. This liquefaction and splitting of the elements takes place swiftly and silently in the columns, because greatly compressed air, when its pent-up energy is given off, relinquishes so much heat that it can no longer remain in its original form nor hold its two elements together.

Each of the liquefaction columns has a capacity of five hundred cubic meters of nitrogen per hour. The yearly capacity is 40,000 tons of pure nitrogen. This is sufficient nitrogen, when mixed with other fertilizing elements, to use in a season on two million acres of land.

As the nitrogen gas, split from the oxygen, comes from the liquefaction columns, it passes on through pipes to meet the ground and powdered carbide. Only a few minutes before it was free overhead and for ages a seemingly inseparable twin of oxygen.

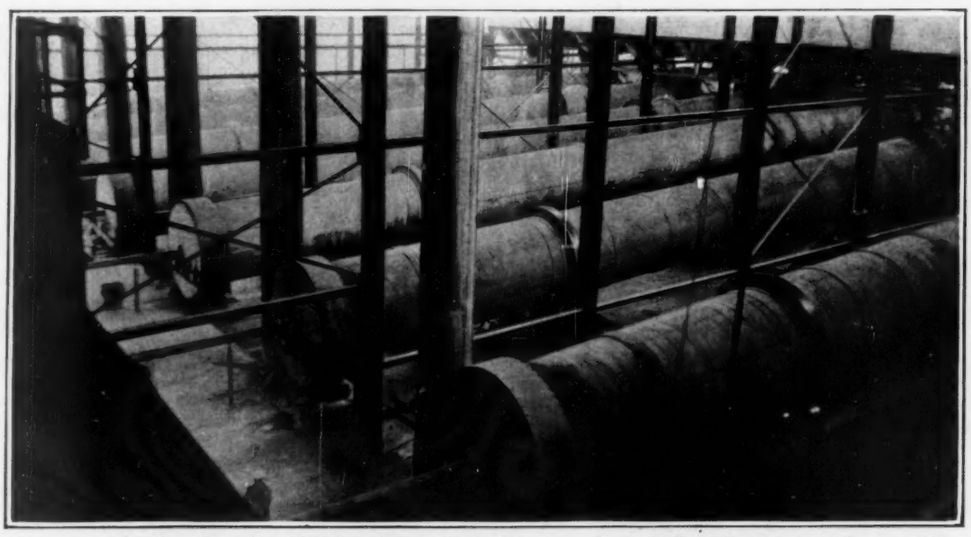
The nitrogen from the liquefaction columns meets the carbide in the lime nitrogen oven room where the reaction takes place; the wedding of that which is plain and solid to that which is fascinating and elusive. Here are more than fifteen hundred ovens and the ingot from each weighs sixteen hundred pounds. Into these ovens, filled with calcium carbide, a stream of nitrogen gas is turned, passing upwards through the mass. The central part of the charge is electrically heated to high temperature by a carbon pencil. And here the nitrogen—shortly before free in the air—is "fixed" for commercial use; here it unites with the carbide.

The product is known as cyanamid, or lime nitrogen, and for future use is ground into a fine powder. From it can be obtained various nitrogenous products—ammonia, nitric acid, ammonium nitrate, ammonium sulphate and ammonium phosphate.

Obtaining ammonia, nitric acid and ammonium nitrate from cyanamid is an entrancing chemical drama. The lime nitrogen is charged into heavy-walled steel cylinders called autoclaves, that contain a solution of caustic soda. Steam is introduced, and, under definite pressure conditions, ammonia is produced.

The oxidation of ammonia to nitric acid is through the dramatic Ostwald process. A mixture of ammonia and air (one volume of ammonia to nine volumes of air) is passed over a gauze of fine platinum wire, electrically heated. This gauze—more costly than fine gold—is known as the catalyst, or "marrying parson." It unites two elements and elemental forces yet loses nothing from itself. Without giving up any of its own potency, it continuously unites the oxygen of the air and the ammonia. The resultant nitric oxide, on cooling, is further oxidized to nitrogen peroxide. Then this is passed through large acid towers where, in contact with water, it is absorbed to form nitric acid. There are six catalyzer apartments, each with more than a hundred catalysts; and there are twelve acid towers.

This scientifically synchronized and electrically motived operation is in perfect condition. Every bearing is oiled and not a fleck of paint or enamel is missing. There is not a faulty connection throughout. It was designed and built for continuous day-and-night operation. Today it is invitingly ready for capacity production. All that is needed is for the current to be turned on. Up to this time the hand of Congress has not moved the switch that will send eighty thousand horsepower of electric energy through this wonderful machinery and equipment that produces—from coke, limestone and air—fixed nitrogen in vast quantities to create new wealth from the soil.



Immense rotary lime kilns in which limestone is burned to secure lime which, with coke, is to form carbide

Our Point of View

Municipal Vandalism

THE LEADING city of the United States is threatened with an act of vandalism which we do not hesitate to say is without a precedent in the history of the country. It will take the form of the complete destruction of one of our oldest and most important and beautiful engineering structures, which was constructed to form a vital link in the water supply system of New York City. We refer to what is known as the High Bridge Aqueduct, which for three-quarters of a century has spanned the Harlem River near the northern limits of Manhattan Island.

The proposed destruction of this bridge is no mere local question, affecting only this city; for it is safe to say that every American citizen who has visited the commercial metropolis of the country, or hopes to do so at some future day, considers the notable aqueduct across the Harlem River to be one of the monumental constructions of New York that are well worth the trouble of a visit.

Announcement of this act of vandalism (we can call it nothing less) was made in the daily press, whose readers were informed that the Board of Estimate had sanctioned the demolition of High Bridge, which spans the Harlem River, where it has long been considered a menace to navigation. The Board had directed the Commissioner of Plant and Structures to prepare plans and specifications for razing the structure and at the same time the Department of Water Supply, Gas and Electricity, was asked to prepare plans for an aqueduct under the river to replace the pipes now on the bridge, at an estimated cost of $1,600,000. The inevitable outcry of the public has met with the equally inevitable promise to do nothing destructive for the present.

Historically, the bridge is perhaps the most striking monument of the inauguration, three-quarters of a century ago, of the Croton Water Supply. Moreover, it has served to perpetuate the memory of one of our foremost engineers, J. B. Jervis, who built the Erie Canal, the Croton Water Supply, and the Hudson River Railroad. From the engineering and architectural standpoints there is every inducement to preserve this truly handsome structure. It is the only work of its kind in this country that may be compared to the famous aqueducts for the supply of the city of Rome. Furthermore, at a comparatively small cost it will be possible, without detracting from the artistic appearance of the bridge, to build upon it a greatly needed roadway, 20 feet in width, to fill in the gap of a mile or so between the bridges at 155th Street and 181st Street, which is now without any cross-river thoroughfare.

What makes the present action of the city government so exasperating is the fact that, when this question was raised some two years ago, the Board of Estimate, in answer to a widespread protest against the demolition of the bridge, appropriated $900,000 for remodeling according to a plan which had been reported as practical by a board of thoroughly competent engineers. The question of razing the bridge was brought up at that time by the necessity of getting rid of certain piers which at present obstruct navigation in the Harlem River. The Board of Engineers above referred to reported that it would be practical to remove two of the obstructing piers, with their superstructure, and span the river with a single arch, that would conform to the general architecture of the bridge, and would, if anything, add to its artistic appearance.

At present the top of the aqueduct contains two water mains of about three feet diameter, and a third of seven feet; and the fact that the present administration, after going to the cost of razing the bridge proposes to build a new aqueduct under the river at a combined cost of $1,600,000 is an admission that the present high-level aqueduct is, today, a useful part of the city water supply system. This attempt to wreck a monumental work may serve a useful purpose, if it reminds the good people of New York that it was rendered possible by the fact, that so many of them preferred the motor car and the golf links to a few minutes spent at the polls on the day of the last city election.

Our Quest in the Psychic Field

PIONEERING is always difficult but always interesting. When this journal embarked upon its psychic investigation several months ago and announced a prize offer of $2500 to the first person producing a genuine psychic photograph, and $2500 to the first person producing any other genuine psychic phenomenon of the physical order under our test conditions, we all looked forward to immediate results—not necessarily convincing results, please understand, but at least results which would throw definite light on this mysterious subject.

Several months have gone by. As yet, so far as our own laboratory tests are concerned, we have nothing to report. And the fault does not lie with us. We have not been idle all this while; not only have we worked out the numerous details of our laboratory tests and made the necessary arrangements for equipment and facilities, but we have solicited the cooperation of all persons reputed to possess psychic powers. Obviously, our efforts must be absolutely unavailing if we do not have the cooperation of mediumistic persons.

It is interesting to note how our psychic investigation has been received. The public at large has signified the utmost interest and proper respect for the work which we have undertaken, for it is realized that the time has come to prove, if it can be proved, whether this whole psychic matter is one gigantic hoax or a new and uncharted field of science. Thinking people want the question to be answered one way or another; too long it has dwelt in the regions of the mysterious and intangible. And just as the SCIENTIFIC AMERICAN investigated the lavish and seemingly impossible claims of Roentgen when he announced his discovery of X-rays to the world; just as this journal investigated the various perpetual motion machines and exposed the fallacy of the idea and the frauds that were being practiced; so we are now determined to get down to the bed rock of this psychic mystery, difficult and all but baffling as it is to come to close grips.

On the other hand, the attitude of mediums, so far, has been uncertain and not over encouraging. The well-known mediums—mediums who are reputed to possess the kind of powers which we desire to study—have not as yet come forward to aid us in our quest. True, there have been dozens, even hundreds, of applicants who claim possession of certain psychic powers; but unless satisfactory proof is first submitted, indicating that the applicants have held sittings and shown results, we are frank to state that we cannot consider them at this stage of our investigation. The elaborate nature of our tests, and the time and trouble involved in assembling our eminent judges and assistants, makes it imperative that, for the present at least, only persons of recognized psychic powers be tested.

Meanwhile we have to record an interesting development. Sir Arthur Conan Doyle, who needs no introduction here, and whose interest in our investigation is well known, invited us to visit the psychic centers of Europe under his personal auspices. We accepted his invitation, not only for the purpose of obtaining first-hand information regarding European psychic work and meeting the leading workers over there, but for the purpose of perfecting our own technique in controlling phenomena. In order that our plans should not be divulged too far in advance, since, according to Sir Arthur, such knowledge might militate against the full success of our European investigation, we dispatched Mr. J. Malcolm Bird of our editorial staff and secretary to our psychic committee, to England on February 10 last, incognito and unannounced.

Now, at the present writing, Mr. Bird has attended various seances and has learned much regarding the ways in which European workers carry on their psychic investigations. His first report appears elsewhere in this issue and others are to follow. Mr. Bird will probably go to Paris to meet the leading French investigators and to take part in their sittings. Also, if the necessary arrangements can be made, he will visit Munich, where Willie S., who is said to be the most remarkable medium yet discovered, has convinced over one hundred prominent German scientists of the objective reality of ectoplasm, according to reports.

It should be noted that our European survey has no direct connection with our prize offers. Mr. Bird's present investigation of the European psychics is being carried out single-handed, without our judges and psychic committee, and also without instrumental control.

New York to Buenos Aires by Rail

THE TIME is approaching, and will come sooner than most people expect, when it will be possible to travel in comfort by rail from New York, Chicago, or San Francisco to Brazil, Santiago, or Buenos Aires, by the Pan-American Railroad. This great North-and-South line is a stupendous project. It cannot be stated just when the idea originated, or where. Thirty years ago or more it formed the subject of frequent editorial comment and descriptive articles in the technical press, and particularly in those devoted to railroad construction. We have not heard very much about it of late years; but the work has gone forward intermittently and more rapidly than is generally understood.

The scheme in its entirety involves large figures and heavy costs, the total length of the line being 10,116 miles, which is not so very far short of the combined length of the three shortest of our trans-continental systems. It should be understood that the enterprise does not, and never did, contemplate the building of an entirely new system of that length; for much of the route is made up of already existing stretches of national railroads. Taking New York as a starting point, the line runs to the Mexican frontier, and from thence through Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia, and Argentina, to Buenos Aires. Even today it is possible to travel by railroad from New York to the frontier of Guatemala; but from Guatemala to the Canal Zone over half of the line has yet to be built. The longest stretch of uncompleted line is from the Canal Zone to the boundary line between Peru and Bolivia, where, out of a total of 3362 miles, only 542 miles has been completed. Also there is a stretch of 127 miles in Bolivia on which work has recently been commenced. The line from Bolivia to Buenos Aires, a distance of 1060 miles, has been completed. To date, 6500 miles out of a total of 10,116 miles have been built. Increased prosperity, and the inflow of capital to South America, have given new stimulus to the project, and in the opinion of the Pan American Union this great scheme is at last within measurable distance of completion.

Will the Sailing Packet Come Back?

IN ALL the age-long history of navigation there has never been a craft that appealed so strongly to the imagination as the American clipper ship of the middle years of the nineteenth century, built though it was for strictly commercial purposes. There was that in those gallant craft and the men who drove them across the seven seas, which appealed mightily to the sporting instinct which is, or ought to be, in all of us. Every voyage was a race, whether the clipper ship set sail with a cargo of human freight for the Eldorado of the California gold fields, or spread its wings for the swift homeward run, with tea from the ports of far distant China.

Our Point of View

Wonderful specimens of the art of the shipbuilder and the sailmaker were those American clipper ships. None of your bluff bows and full quarters for Donald McKay and his rival designers. They knew all about the sharp entrance, the rounded bilge, and the long easy run, by the judicious combination of which the hulls could be driven through the water at from fifteen to eighteen knots when the conditions of wind and sea were favorable. And as for the sail plan, were the ghost of one of these famous clippers to come sailing into the Ambrose Channel, the sailormen today would gaze aghast at her towering spars and the unbelievably vast spread of her canvas, with the billowing stun'-sails at every yardarm.

Now these reflections are prompted by the receipt of a letter from Mr. Samuel W. Banning of Chicago, who in suggesting that it would be worth while to revive the passenger clipper ship, or to be more exact the "sailing packet" of the last century, is voicing a thought which has been rather freely expressing itself of late among those who love the sea for its own sake, and who believe that its charm is never so fully realized as from the deck of a well-found sailing vessel. He expresses surprise that no one, to date, so far as he is aware, has "seriously advocated the possibilities of the auxiliary sailer for passenger service of a specialized character. Since the fascination of voyaging under sail is being widely appreciated by yachtsmen, why," he asks, "is the public at large forever relegated to the dull monotony of hotel life on a steam liner? The auxiliary sailer—the clipper ship with enough motor power to maintain a reasonably certain schedule—makes her appeal to the large and growing number of persons who demand, in sea life, something more colorful than figured upholstery, moving picture entertainment, and a la carte table service at all hours."

Now we are satisfied that these sentiments will appeal to every yachtsman, and to that very large number of people who take the slower steamships in order to make sure of a longer time upon the ocean. Of course, the vast majority of ocean travelers regard the ocean trip as an incident in a journey that is made either for business or sightseeing. To them, and to all who are troubled with seasickness, high speed is a prime consideration; but there can be little doubt that the sentiments of our correspondent will find an echo in a surprisingly large number of those who, for the very love of the thing, "go down to the sea in ships."

Our correspondent passes on to point out that the advantages of a swift sailing passenger ship would be much more than negative, more than the mere escape from the gilded glory of hotel life. "In the matter of real comfort," he writes, "the passenger clipper may easily prove more than a match for the best the liner has to offer. Wide sweeping decks, freedom from smoke or dirt, absence of vibration, steadiness in a seaway—in all these respects she might well surpass the average steam-driven vessel; while in her matchless beauty, in the fascinating details of her navigation, and in the interest which attaches to her history and to the place which she has occupied in song and in literature, there can be no comparison whatever."

It will be understood that, should such a sailing passenger ship be built, she would carry auxiliary power to take her into and out of port, and help her through stretches of calm weather. Granting this, a ship of, say, two or three thousand tons, modeled on the fine lines of a modern yacht, built of steel, with steel masts, high-grade steel rope, etc., could be made to show a turn of speed greater even than that of the wooden clipper ships of the last century.

The Railroads and Port Facilities

AT THE close of last year the Interstate Commerce Commission ordered the railroads which serve the Port of New York to show cause why they should not cooperate with the Port Authority in its endeavor to coordinate the facilities of the Port. We regret to say that, up to the present writing, the railroads have shown a spirit of opposition to the Port plan; with the result that the Port Authority, which hitherto has treated the railroads with great courtesy, is now taking a stronger tone, and reminding them that it has behind it the unquestioned powers of the Interstate Commerce Commission.

In previous issues we have shown what a great step in advance was taken when New York and New Jersey buried their political differences, and got together in an effort to bring order out of confusion, by coordinating the terminal activities of the railroads by means of a belt line connecting them all, and the formation of a general reclassification center. The plan, at least in its main outline, receives our unqualified endorsement; for we believe, and have long believed, that only by a unified system of handling incoming and outgoing freight at this great and rapidly growing center, will it be possible to reduce the cost of handling at New York. This, today, is greater than the whole cost of hauling freight from points five hundred to seven hundred miles from the seaboard. The high cost is explainable by the fact that the nine railroads terminating at Jersey City, to say nothing of those that reach New York from the north and northeast, are maintaining each its own separate terminal—an archaic and inherently extravagant practice. The Port Authority would leave each railroad untouched as to its line-haul profits, but it would unify the present terminals by gathering into a terminal pool all the freight which converges at this port.

Far be it from us to criticize our railroads unjustly. Although we were one of the first journals to advocate strongly the regulation of the railroads by an Interstate Commerce Commission, and although we believe that Commission has done incalculable service, up to a certain point, both for the public and the railroads, we believe that in its zeal to please the public it has overshot the mark and has laid burdens and embargoes upon the railroads, which are largely responsible for their present distressed condition. Furthermore, we believe that every credit should be given to the railroads for the supreme effort they are making to repair the neglect of government operation, and show a profit in spite of the overdone zeal of the Interstate Commerce Commission.

What the railroads need today is public confidence and sympathy, and we believe that their standing with the public would be greatly strengthened by cooperation with the Port Authority in its effort to untangle the freight situation in the Metropolitan district. For it should be remembered that the situation at New York is no mere local affair; rather it is a problem which affects, in greater or less degree, the freight rates to and from every city throughout the country.

Seventy-Five Years Ago

WE SPENT a leisure hour the other day turning over the pages of the SCIENTIFIC AMERICAN of 1848. The record proved to be historically of such interest, that we culled a few items of those far-away days and herewith pass them on to our readers.

Transportation came in for a large share of editorial attention. A special article devoted to Clark and Varley's Atmospheric Railroad, gives reasons why it was unable to compete with steam, the chief trouble being the difficulty in exhausting the tubes, and the proper closing and opening of the pneumatic valves. The pneumatic railway proved very attractive in the first half of the nineteenth century, the great Brunel trying the system on the Great Western Railway.

It is interesting to discover a mention of that famous express engine of early days, "The Lightning," which represented an extreme example of the movement in the direction of large-diameter driving wheels. We are told that this engine, with eight-foot driving wheels, made a trip of 53 miles, at the rate of 75 miles an hour. This, of course, must have been a burst of speed over a short measured distance.

Under the head of "Novelties in Steam Engines" reference is made to engines which have double cylinders, "one a high-pressure, non-condensing, and the other a large cylinder, to use the escaped steam from the high-pressure cylinder and then condense it." Evidently the editor of those days preferred the simple, single-cylinder, high-pressure engine, emphasizing the fact that it is "less expensive and more simple—important considerations." He looked with favor upon the plan of using the exhaust steam from a single high-pressure cylinder to run a compact rotary engine.

Steam engineers were reaching out for better mechanical methods of utilizing the energy of steam, and two drawings are given of an oscillating engine; a type which was beginning to have a considerable vogue, and for steamship propulsion lasted well into the early '80s.

The microbe of "Superlativitis" is older than we had thought—it is not a product of the modern newspaper scribe; for someone who signs himself "G. R." submitted in 1848 an article entitled "Steamboat Speed," in which he quotes a certain Baron LeGuier as having informed him that he made the trip from Havre to Bologne in a new English Steam Packet at the rate of 30 miles per hour. He goes on to say "the success of the swift steamers we have mentioned is owing to new patent engines invented by Maudslay and Field of London, and it is quite common for their boats—all iron—to run 22 miles an hour at sea." Well, we had to wait half a century for any kind of a boat to make 30 miles an hour, and deep-sea passenger steamers have not done it yet.

The propeller, as distinct from the paddle-wheel, was receiving its full share of attention even in that early day. We read of a St. Louis citizen who tried out "a kind of aquatic steamer at St. Louis, which was driven by a propeller shaped like the tail of a whale."

Railroading was even yet in its infancy, and the Trans-Atlantic Railroad was a dream of daring. Thus, we find a note entitled "Oregon Railroad," which states that the House of Representatives had appointed a committee to consider the building of a railroad from Lake Michigan to the Pacific, as proposed by Mr. Asa Whitney; and eighteen States through their legislatures had adopted resolutions approving the project.

The coming of the railroad meant the waning of interest in the Canal—at least for the time being; but Chicago will note the following: "The opening of the Illinois and Michigan Canal is an event in which Chicago has a deep and direct interest. . . . On the passing of the first boat into the harbor amid the salute of a hundred guns, the Illinois and Michigan Canal was declared open."

Under the caption of "Clairvoyance" editorial comment is made upon the rumored discovery through a clairvoyant of the body of a young man in Boston. "There is something essentially wrong in placing confidence in such nonsense. It pains us to think that, for all our boasted civilization, so much superstition should exist."

There is something very familiar about the caption "Congress and Inventors." It seems the Senate had passed a bill granting a salary of $2500 to the principal examiners, and the House had cut it down to $2000. "The bill, instead of being in the prospective of becoming a law, has a fair prospect of being left to confer a bad name upon the character of our country, as represented by the members of Congress." That sounds familiar, as does also the following: "The Patent Office is about ten months behind in examinations, and we say that it is a shame for our Representatives to act toward our inventors as they have done. Why did they seek to cut down the $2500 to $2000? Surely they do not know that there are but few men in the country capable of filling the offices referred to." This voice of three-quarters of a century ago sounds curiously suggestive of what we wrote in our issue of last month.

Trinil Man of Java, or Pithecanthropus. 500,000 years ago

Piltdown Man or Eoanthropus. 125,000 years ago

The "Cave Man" or Neanderthaler. 50,000 years ago

The Reindeer or Crô-Magnon man. 20,000 years ago

Restorations based on the skulls of four races of Old Stone Age men—the first three left no descendents

Extinct Races of Ape-Like Man

Tracing the Evolution of Man and the Apes from a Common Ancestor

All illustrations copyright, American Museum of Natural History

IT IS one of the most peculiar if not vexatious turns of fate that of all the animals at present living, the fossil evidences of the origin of our own species are among the scarcest and most fragmentary. Geologists have much less trouble, for instance, in tracing back the stages in the evolution of the horse and the rhinoceros than that of man. A single room would easily contain the entire collection of the original fossils of the Trinil, Piltdown, Heidelberg, Neanderthal and Crô-Magnon men now in our possession, while those of the few discoveries of men and ape-like men more than 50,000 years old could be placed in a handbag. Therefore, those we see exhibited in museums, such as those shown in one of our views, are exact replicas of the originals, whose value is so great that a comparison with their weight in gold would be ridiculous. Yet, around these few priceless fragments has been published an immense volume of critical literature.

Had most of these early kinds of men and near-men not been forest dwellers, had they been plainsmen or rivermen, rather, we should have much less difficulty in finding their remains in ample numbers. But man has, until comparatively recently, been a water shunning animal. The fact that, unlike the other mammals, he must consciously acquire the art of swimming, alone shows that he did not evolve in contiguity to the water. If an animal habitually dwells near the water, or enters it at times to catch fish or for other purposes, a portion of its individuals will meet their death there, and fall into the shallow lagoons or marshes where they are soon covered with ooze, and remain undisturbed until fossilized. Even those which die on the plains, instead of in the forest, may often lie undisturbed until their bones bleach and are finally covered with windblown sand. But the forest-dwelling animal is either devoured, or falling into the tangled mat of damp, decaying vegetable matter beneath the shrubbery, is attacked by the humic acid generated when the fallen leaves decay, and its bones are soon disintegrated. The valuable record is thus lost forever. For this reason it is only in rare instances that our earliest man-like ancestors have left us records of themselves. And in still rarer instances have we been able to locate these remains.

When we come down to more recent times, within about 50,000 years, the record is less disappointing. The men who lived in these times, such as the Neanderthal and Crô-Magnon men, were driven by the cold, raw climate brought about in Europe by the Glacial Period, to take shelter in the many caves that are found in the limestone strata of France, Spain and Germany. There they were protected from the cold as well as from the attacks of the giant beasts of which so many are now extinct. Retreating to the shelter of these caves, near the mouths of which they built fires for warmth or to sear their meat, it is quite natural that they should have left many traces of their daily manner of living, such as weapons discarded or lost in the debris, remains of their fires, bones of the beasts they had been able to kill with their crude weapons, and in many cases, their own bones. From such clues as these the anthropologist is able to piece together a picture of their lives, what they ate, hunted, and did with their spare time, as well as the sort of implements they made and used. More important still is the evidence of their own bones, from which the osteologist, understanding fully the mechanical principles that govern bone structure, is able to deduce a chain of facts which appear on first thought to be unrelated to the original.

The early biography of man is written in a cryptic tongue. It is only by most laboriously fitting together the fragments of knowledge thus gained, as well as the fragments of bones found, that we are enabled to get an idea of the sort of a being we are descended from. Whoever approaches the subject hoping to find a full, lucid record already prepared, will soon be disappointed. What we know as yet really represents only an occasional contact with the earliest of our ancestors. We have only hit a few of the high places, and with these we are forced to make the best until more discoveries can be made.

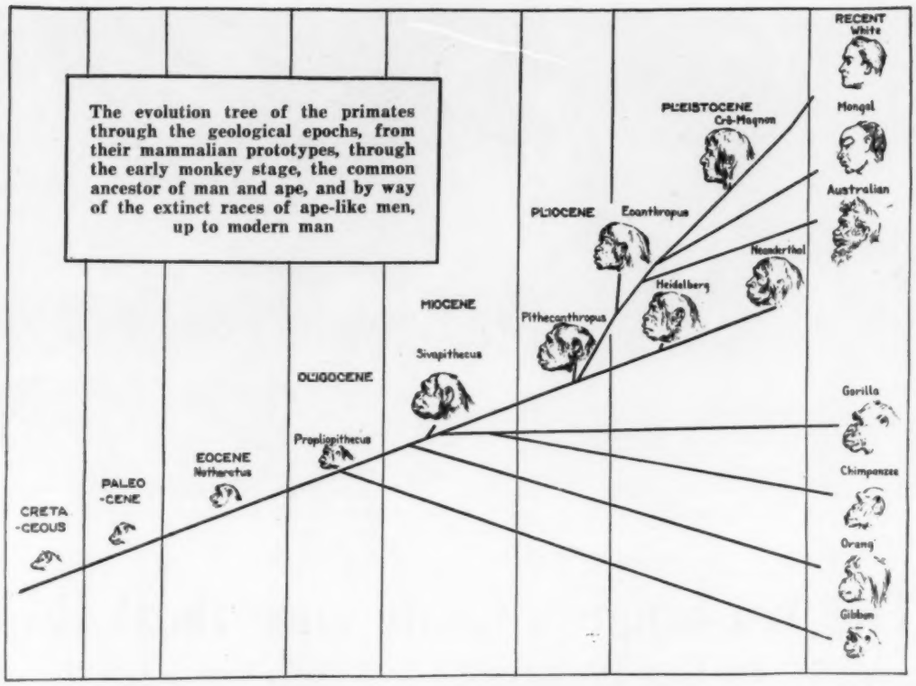
In order to connect the evolution of the human species with the earliest forms of life it is necessary to begin long before the apes and men had evolved from the general mammalian stem. It is highly difficult to be specific about the age of the original mammal, but we can say that mammals were beginning to develop from an earlier form within something like 15,000,000 years ago. It may have been more, and was hardly less, although it is very difficult to get geologists to commit themselves within a few millions of years in these matters. At that time, in the Cretaceous Period, the dominant life of the world was reptilian. The mammals were as yet of little importance. They were not to gain much headway until about 5,000,000 years ago, in the Eocene Epoch of the Tertiary Period, Cenozoic Era, when the mammoth reptiles we see in museums, such as the brontosaurus and diplodocus, had become extinct. Referring to the illustration showing a "family tree' of the primates, the diagram which our article is to follow through almost exclusively, the first two heads are sketched in as more or less general mammalian types. They might as easily, for instance, be taken for the prototypes of the dog or pig, as for those of the rat, hyena, or monkey. At the time the mammal had not yet divided and subdivided into the hundreds of species now extant.

The Eocene Epoch finds the mammals increasing in numbers and in species. They throve and dominated the earth, just as they do today—in fact, a little more so, for a number have since become extinct. A complete Eocene family tree of the mammals would have hundreds of branches, but we are forced to drop, from now on, all but one—that of the higher Primates. These Primates include the monkeys, the lemurs, the apes, the man-like apes, the ape-like men, and man. The monkeys are not shown on the tree, but they split off during these times, and from now on we are through with the monkeys, as well as the word "monkeys." We

Skulls of the four races shown above. The chin is entirely absent until the more recent Crô-Magnon man is reached

shall frequently deal with the orang-utan, chimpanzee and gorilla, but these are apes, not monkeys. To say that "man descended from monkeys" is untrue. But it is accurate to say that man and monkeys, as well as the apes, both descended from a common stock. Also it must be remembered that this stock was not monkeys as we know them when we see an Italian organ grinder with one, but that the monkey has evolved and changed in one direction, just as man has changed in another. We are collateral species, the ape being our first cousins, as it were, the monkeys first cousins once removed, and the dog, horse, or the seal, for instance, being "second cousins."

Propliopithecus of the Oligocene Epoch of our tree is the name assigned to a very primitive anthropoid or "man-formed" ape which is sometimes regarded as a possible ancestor of all the apes and man. The gibbon is an offshoot from this time. Instead of becoming partly erect, the gibbon has gone down on all four limbs and has developed an appearance somewhat like that of a dog, though the resemblance is, of course, accidental. Propliopithecus was a comparatively small animal which lived among the trees and may have resembled the gibbon in some respects.



The evolution tree of the primates through the geological epochs, from their mammalian prototypes, through the early monkey stage, the common ancestor of man and ape, and by way of the extinct races of ape-like men, up to modern man

The Miocene Epoch began about 2,000,000 years ago and brought mammalian development to its culmination. The many mammals which had been evolving through the Eocene Epoch had become more settled in form. Sivapithecus was an early ape whose fossil bones have been found in India. He presents elementary man-like characteristics, but he is still an ape. Man, with his much better developed brain, was yet to come. From creatures like Sivapithecus descended the orang, the chimpanzee, the gorilla and man. The orang is the older offshoot of the three apes. The gorilla resembles the chimpanzee more than he does the orang.

We must, then, trace our genealogy and that of the apes back about 2,000,000 years before we come to a common meeting point with the ancestor of the apes, while our separation from the monkeys is one or two millions of years greater. While the geologist is unwilling to be dogmatic in assigning definite values to the lengths of the epochs, knowing that such figures are only roughly approximate and may be altered by later discoveries, the average reader wants some statement more definite, more tangible than "a long time ago," and for this reason, figures which may later be shown to be as much as 50 or more per cent out of the way, are chosen from the average of many opinions. It has been the usual experience that such figures, when revised, have been added to rather than reduced.

Having eliminated from our tree the apes, the real "study of man" or anthropology, begins with the latter part of the Pliocene Epoch, the epoch immediately preceding the glacial epoch. Pithecanthropus was the Trinil man of Java. We believe he was not an ape but a man. Of course there is a place where it is hard to draw the line, yet his skull, which was found in Java, has capacity for a good enough brain to be that of a very primitive man. His skull is shown at 7B in the photograph below, just right of the center. To the left of the skull is a reconstruction of his bust. He may have looked somewhat more like a modern man than this; or he may have been more brutal in appearance. We do not know much about the life of this creature. Flints which were found in the same stratum with him might have been very crude implements, or simply stones having the appearance of implements. This "walking ape-man" may have used these stones simply to smash nuts, macerate his food or to hurl at the creatures he wished to kill for food. From the bone structure of his skull we can tell that the Java ape-man walked comparatively upright, and therefore we know that he had the free use of his forelimbs. This brings us to a pronounced turning point in man's evolution. When the forelegs were freed from walking they are ready to be made into hands. Unconsciously the animal comes to use them more and more for grasping. This soon leads to holding, manipulating and examining things. In this process the brain is developed. Next, the improved brain reacts on the hands, they become more useful, learning to turn things so that they may be critically examined before the eyes. The eyes and observational power share in the improvement. The brain, the hand and the eyes interact and evolve in a sort of geometric progression. Evolution is thus speeded up many fold. Soon, implements are used, a use probably first discovered accidentally. Gradually the thumb, which has been heretofore one of a row of fingers, evolves around into a position opposite the fingers. Then the creature is vastly better able to perform careful work with his hands. Let the reader attempt some operation, such, for instance, as climbing a tree, with the thumb held alongside the fingers. It was the use of his forelimbs for hands that put man so far in advance of the rest of the animals that they were hopelessly outdistanced.

Our pursuit of the early man now takes us into the great glacial epoch, called the Pleistocene. The total duration of this epoch was probably about 400,000 years, and the subsequent time up till today was about 30,000 years. The real development of man was contemporaneous with the Glacial epoch, and was so tied up with its several phases, that it is necessary to stop and learn a few salient facts concerning it. The ice age has seven subdivisions, four representing the four separate invasions and retreats of the great northern icecaps, the remaining three representing the intervals between these invasions. These are termed the first, second, third and fourth glacials; and the first, second and third interglacials, respectively. The glacials are regarded as having been 25,000 years each, the interglacials were about 75,000, 200,000 and 100,000 years each, respectively. Therefore the sequence would be something like this:

1st Glacial 25,000 years
1st Interglacial 75,000 years (warm)
2nd Glacial 25,000 years
2nd Interglacial 200,000 years (warm)
3rd Glacial 25,000 years
3rd Interglacial 100,000 years (warm)
4th Glacial 25,000 years
Postglacial time 30,000 years (warm).

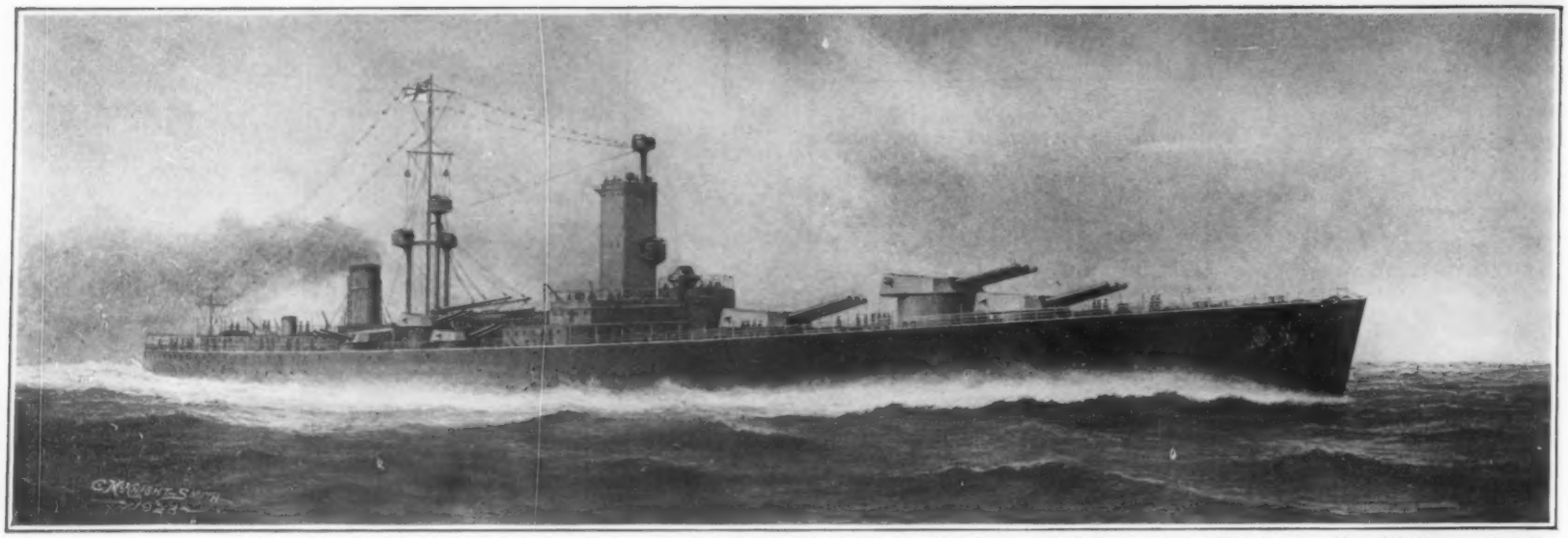
These eight periods of time are constantly used by anthropologists as chronometers because the fossils of most of the archaic men are found in connection with glacial and interglacial deposits of detritus. These deposits can quite easily be placed in their proper sequence and dated with fair accuracy, and it is by this means that the antiquity of the Old Stone Age races may be calculated.

Now as we look back through all this alternation of frigidness and warmth, ice and vegetation, South Polar conditions and conditions bringing back the climate, say, of Spain, we are apt to ask, "Is it not remarkable that man could have had his most phenomenal development from the near beast to the level of the average European during so confused, erratic, unstable a time?" The answer is, first, that the interglacial times were very long, even though they are foreshortened by the perspective of time; and, second, that the great, deep icecap did not extend south of central Europe, and so man was doubtless continuously evolving in other places, only the individuals living within a few hundred miles of the ice-edge even knowing the ice existed. It so happens that we have been able to recover evidence of the latter, but not as yet of the former man. The ice won its way against the diminishing heat of the sun during not one, nor a few, but scores of generations, and when the interglacials gradually came on, the process was reversed. No one man followed the ice-edge back. His great-grandchild might have found it

(*Continued on page 352*)

1, Skull of modern man; 2, Crô-Magnon skull; 3, Skull found in Australia; 4, Neanderthal Man; 5, Jaw of Heidelberg Man; 6, Piltdown Man or Eoanthropus; 7, Reconstruction of Pithecanthropus; 7a, Skullcap of Pithecanthropus, as found in Java; 7b, Reconstructed skull of Pithecanthropus; 8, Skull of young Gorilla; 9, Gorilla; 10, Chimpanzee; 11, Orang-utan; 12, Gibbon

Photograph of a full series of skulls of the higher primates, as displayed at the American Museum of Natural History, New York



Length, 700 feet; beam, 104 feet; draft, 28 feet 6 inches; displacement, 35,000 tons; speed, 24 knots; main battery, nine 16-inch guns; torpedo battery, twelve 5.5-inch guns; side and deck armor, 15 to 5 inches; turret and barbette armor, 16 to 10 inches

A study of the Conference battleship

The Washington Conference Battleship

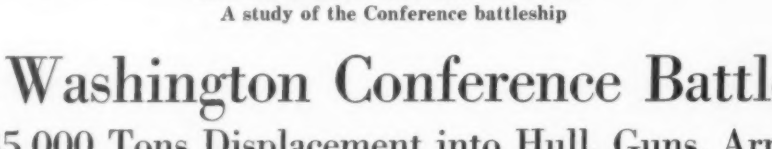
Translating 35,000 Tons Displacement into Hull, Guns, Armor and Speed

SHORTLY after the armistice a leading naval architect, Sir George Thurston, published in Brassey's Naval Annual of 1920-21 an article in which he outlined the features of the probable, or possible, battleship of the future. The design was based upon the trend of battleship design in recent years and upon the lessons of the battle of Jutland. In those days there was no limit upon the size of warships other than that imposed by the facilities of the shipbuilding yards and the depth of the National purse.

After admitting the limitations imposed by heavy cost, he says, "We have, therefore, only to estimate the maximum possibilities in the present position of engineering science, in order to arrive approximately at the type of capital ship which is the ultimate aim of the principal naval powers," and he finds that such a ship would be 932 feet in length, 112 feet broad, and of 31 feet 6 inches draft. It would mount eight 18-inch 45-calibre guns, firing a 3300-pound capped projectile with a muzzle energy of 131,800-foot tons, capable of penetrating about six feet of solid wrought iron at the muzzle. The shaft horsepower for a speed of 33½ knots would be 200,000, and the displacement would be 57,000 tons. The cost of such a ship, says Sir George, would be prohibitive to all but the most powerful nations; and even for these the battlefleet would be restricted to a much reduced number of such great ships.

Now this article was written before the Washington Conference, and it serves to emphasize the wisdom of that clause of the Treaty, which restricts the size of future battleships to 35,000 tons. Had it not been for the Conference, Great Britain would now be building four battleships of forty-seven to fifty thousand tons, and if Admiral Beatty had had his way they would have mounted the powerful and costly 18-inch gun. The United States would have countered probably, by going to Thurston's limit of 57,000 tons, and Japan, no doubt, would have followed suit. This would have meant that the future naval appropriations would have been counted not in millions but in billions.

As a most interesting supplement to his previous article, Sir George Thurston has written for the 1923 edition of Brassey's Naval Annual an article in which he shows what it is possible to do under the restrictions of 35,000 tons displacement. He makes three separate studies of the problem and gives the principal dimensions, etc., for three types of ship; one with the greatest number of large-calibre guns, the maximum amount of protection, and a moderate speed of 24 knots; another with a reduced number of large-calibre guns, somewhat lighter armor, and a high speed of 30 knots; the third design is for a battleship with the maximum number of guns, but with very light armor (for a battleship), and a speed of 30 knots. He is of the opinion that the first type, conforming broadly to the modern battleship of the type of our own "Maryland" and the British "Royal Sovereign," is the one which probably will be adopted.



Deck and gun plan of the Conference battleship

The accompanying illustration, which is based upon a sketch by Percy F. S. Spence, drawn for Sir George's article in the Annual, shows with considerable detail the general appearance of the ship. In view of the professional standing of the author and his intimate relation with British naval construction, it is probable that the two 35,000-ton battleships, which Great Britain is beginning to build under the treaty, will conform rather closely to the design here shown. The principal features of the ship are shown under Plan A in the accompanying table.

The first impression of the ship is that of its extreme novelty, with the whole of the main battery forward, the motive power aft, and the secondary battery grouped snugly amidships. This novelty, however, is incidental; for the ship has been designed to conform as closely as possible to the lessons that were taught at the battle of Jutland. The grouping of the nine 16-inch guns in three triple turrets forward is done to secure heavy end-on fire, and also a wide arc of fire of over 300 degrees. Another most important advantage is the superior protection of the magazines which is possible. Three battle cruisers were blown out of existence at Jutland by shells, or the flash of them, which penetrated to the magazines. Boilers and engines may be partially disabled, the steering gear also, and the ship may still fight on; but let a high explosive shell reach the main magazines, and there will be no ship left to fight. Grouping the guns in this way, then, has the added advantage that the side and deck protection of the magazines, being concentrated, can be considerably thickened. Successive steel decks, horizontal and sloping, will place the magazines of the main guns on this Conference battleship beyond any possibility of disaster—in other words, the shells will be detonated before they reach the protective deck.

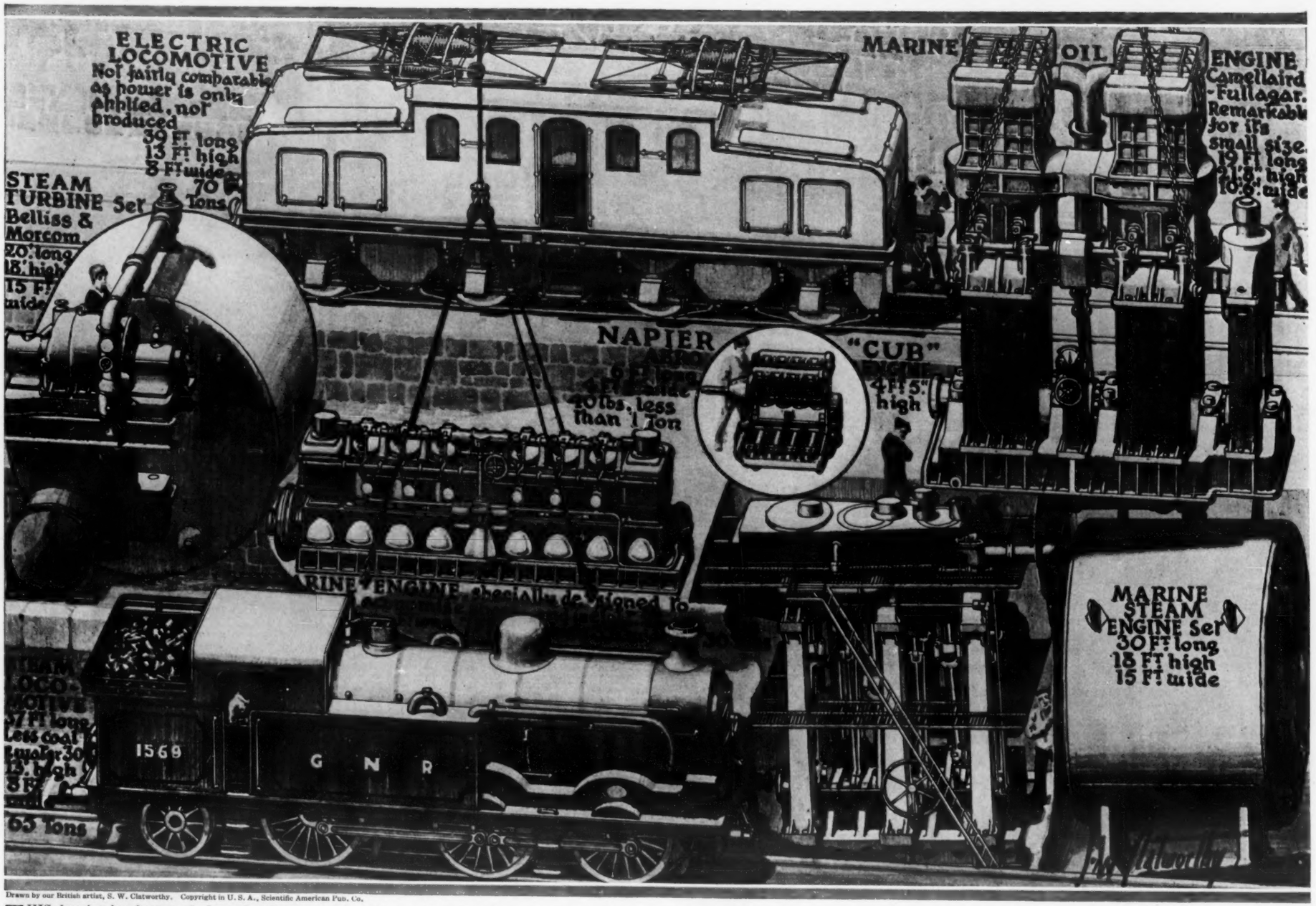
The great concentration of gun weights forward is balanced by the placing of the machinery in the after third of the ship. Immediately abaft of amidships are grouped the six turrets that contain the battery of 5.5 anti-torpedo guns. The armor on the sides and decks ranges from 15 inches to 5 inches, and it is a pretty safe guess that the larger portion of this, because of the steep angle at which the shells will fall in future sea fights, will be devoted to horizontal and inclined deck armor. The 16-inch gun positions will carry armor varying from 16 inches in the port plates to 10 inches in the barbettes and in the sides and rear portions of the turrets.

In the drawing, our artist has shown the guns at half elevation, suitable to fighting at medium, modern ranges; but with the powerful 16-inch gun, and with the probability of engaging the enemy as soon as he can be reached, it is quite possible

(*Continued on page 357*)

Three Alternative Designs for a Washington Conference, 35,000-Ton Battleship

	PLAN "A"	PLAN "B"	PLAN "C"
Length	700 ft. 0 in.	730 ft.	770 ft.
Breadth	104 ft. 0 in.	104 ft.	104 ft.
Draught	28 ft. 6 in.	27 ft. 9 in.	26 ft. 6 in.
Displacem't (Conference)	35,000 tons.	35,000 tons.	35,000 tons.
Displacement inclusive of 1,000 tons fuel for trial condition	36,000 tons.	36,000 tons.	36,000 tons.
S. H. P.	55,000	125,000	120,000
Speed in knots	24	30	30
Primary armament	9 16-in., 45-calibre guns, triple mounted.	6 16-in., 45-calibre guns, triple mounted.	9 16-in., 45-calibre guns, triple mounted.
Secondary armament	12 5.5-in. or 6-in. guns and the usual anti-aircraft guns, etc.	12 5.5-in. or 6-in. guns and the usual anti-aircraft guns, etc.	12 5.5-in. or 6-in. guns and the usual anti-aircraft guns, etc.
Armour on sides and decks	15 in., 14 in., 13 in., 7 in., 5 in.	13 in., 10 in., 7 in. and 5 in.	8 in., 6 in., 7 in.
Armour on gun positions.	16 in. to 10 in.	14 in. to 10 in.	12 in. to 10 in.



Drawn by our British artist, S. W. Clatworthy. Copyright in U. S. A., Scientific American Pub. Co.

THIS drawing has been worked out for the purpose of demonstrating the remarkable power and compactness of present-day airplane power plants. Here we have the most powerful airplane engine in the world to be flown successfully, the new Napier "Cub," shown in the circle, which marks one of the most startling achievements in the history of engineering. Its extraordinary economy of space, weight and material is indicated by comparison with other typical power producers, all drawn to an equal scale.

The airplane employed upon the occasion of the recent first flight of the Napier "Cub" was the "Aldershot" bomber, of 64-foot span, the largest single-engined machine extant. However, since this bombing plane was previously flown with a 700-horsepower motor, a considerably larger airplane is within the new engine's capacity. The trials showed an unexpected increased speed and climb. Probably the birth of the true giant airplane, as distinguished from multiple-engined airplanes, will date from this first successful flight.

This drawing also affords an interesting comparison of various power producers of approximately 1000 horsepower each, with the dimensions, and in some instances the weight, involved. The machines depicted are, of course based on British, rather than American, practice.

WHAT ONE THOUSAND HORSEPOWER MEANS IN POWER PRODUCERS ON LAND AND ON WATER AND IN THE AIR

Two views of the gliding boat shown in our cover picture, which carries four passengers at a good rate of speed. Wheels enable the craft to be driven on land

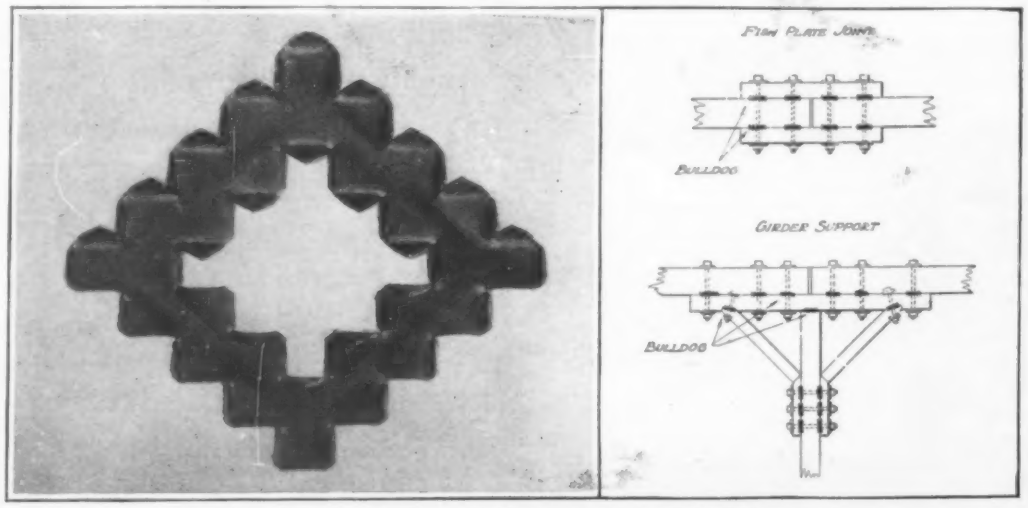
A Man-Made Amphibian

FOR some reason—probably on account of its novelty—people have been trying to build a successful boat that would also travel on its own bottom, or on its own wheels rather, upon dry land. Here we illustrate Count De Lambert's effort, which is described as his most recent production in the way of gliding boats. We are told that, in general make-up, "it consists of two flat box parts with a projecting offset in the middle," which, being interpreted into American parlance means, we take it, that the Count has built a hydroplane with a single step. The craft is quite diminutive, measuring only 5 feet in beam by 16 feet 8 inches in length, dimensions which are advantageous when it comes to handling the boat ashore, whether in travel on highroads and streets of a city, or in a garage. The accommodation is for four people, who are protected from spray and solid water by a coaming, at the front end of which is a windshield. It should be explained that the boat is provided with four easily detachable wheels, which are mounted when it is desired to take the boat ashore. Steering in water is done by twin rudders, each of which is mounted at the back of the boat and flush with its sides.

Propulsion is effected by a 35-horsepower Anzani engine, which runs at a standard rate of 1450 r.p.m. The engine, with its propeller, is mounted astern upon a framework built up of steel tubing, and the air propeller, being clear of the water, is available for driving the craft when she is ashore. The fuel tank holds some 15 gallons of gasoline, or sufficient for a three-hour run. The boat is of very light construction, weighing only 815 pounds when empty. It is built of wood internally braced with steel. Loaded, it weighs a little over 1600 pounds.

New Type of Timber Joint-Plate

A PROBLEM that is always present in the framing of timber bridge trusses and roof trusses, and of built-up floor girders, is that of so joining up abutting members as to hold them securely in place and preventing any slipping movement. Down through the ages the carpenter has been at work upon this problem, and all manner of devices, such as tenons, wooden keys, scarfing, etc., have been tried. One of the most difficult connections to make secure is that of tying together the abutting ends of two timbers, so as to secure a long tensional member, as in the case shown in the smaller of the accompanying line drawings. The cheapest connection is that in which the two ends are held together by fishplates or clamps, one on each side of the joint, with screw bolts passing through the main timber and the two fishplates. In this case the strength of the joint is that of the sheering resistance of the wood, where the bolts pass through. Where greater strength is required, square keys are fitted into pockets rabbeted out of the clamps and the main timber. This, however, takes time and is costly in labor. The accompanying photograph shows a simple device which consists of a cold rolled steel plate, which is provided with several sharp claws or teeth. The plate, which has a square hole in its center, is placed between the abutting faces of the timber, and the splice bolts pass through this hole and are tightened up against suitable washers, as shown in the drawings. This little device presents a large sheering resistance, and at the same time it requires no carpenter work such as is necessary in the case of wooden clamps, scarfs, etc. The resistance to movement, that is to say, the sheering resistance, should be as great if not greater in one of these bulldog plates, as they are called, than in one of the old framed wooden key joints above referred to. It has the further advantage that there is no loosening up of the connection through shrinkage.



New type of timber joint plate, stamped out of steel plate

World Production of Coal in 1921

THE world's production of coal in 1921 dropped back to the level of 1909. From reports so far received, the United States Geological Survey estimated the total output at approximately 1,100,000,000 metric tons. This figure is subject to material revision.

In comparison with the feverish year 1920, the year just closed shows a decrease of more than 200,000,000 tons. The chief factors in the decrease were the British miners' strike which lasted from April to June, and—more important—a world-wide industrial depression. Prices collapsed early in the year, and the seaborne coal trade of the world fell off sharply. The consequent reduction in the volume of business offered to the shipping of the world has been an important element in the decline of ocean freight rates.

Of the major coal-producing nations, France and Germany were the only ones to show an increase. Progress in restoring the ruined mines of France is indicated by the steady increase in output of the past three years. In 1919, 22,000,000 were produced; in 1920, 25,000,000; in 1921, 29,000,000. A further increase of 12,000,000 tons, however, would be necessary to bring French production up to the level of 1913. German production of bituminous coal is also still far below the pre-war level although an increase was effected in 1921 as against 1920. German production of lignite in 1921 reaches the highest point ever attained. The estimated output of 120,000,000 tons is an increase of 35,000,000 tons over the last year before the war.

The proportion contributed by the United States was 40.9 per cent, a larger share than in the years before the European war, but the smallest in any year since 1916.—Abstract from *Science*, March 31, 1922.

Social Life Among the Beetles

INSECTS are regarded as "social" if the parent or parents live with their offspring and protect and nourish them. Hitherto but three groups of social beetles have been known. Professor W. M. Wheeler has recently added to the list two genera of Silvanid beetles belonging to the family Cucujidæ, discovered by him in British Guiana.

The bulk of his observations concerned the species *Coccidotrophus socialis*.

The beetles of this species enter the hollow petioles of a leguminous tree Tachigalia and either bore their way in, or gain admittance through perforations previously made by other insects. They enter either as a single pair, or one beetle enters and is very soon joined by an individual of the opposite sex. Upon taking possession of their future habitation the beetles remove any loose pith, or the remains of previous tenants, by pushing this debris into the pointed ends of the cavity by means of their flattened heads. This behavior brings the insects into contact with the outermost layer of pith adhering to the walls of the cavity, and certain strips of nutritive parenchyma. The latter tissue forms the food of the beetles, and is also shared by young Coccidæ of the special *Pseudococcus bromeliæ*, which soon begin to enter the petiole-cavity. By means of the feeding action of the beetles, the strips become converted into grooves, the coccids stationing themselves in a row in each groove. The beetles carefully avoid soiling their food material and store their frass in the areas between the grooves. They lay their eggs along the frass ridges, and the larvæ which hatch out feed upon the same nutritive parenchyma as their parents. When mature, they construct brown cocoons with which pupation occurs. The beetles emerging from the latter remain in the petiole with the original pair; they mate and produce eggs and larvæ in turn, thus leading to the climax stage of the colony, which may eventually consist of several dozens of beetles of both sexes, and many larvæ and pupæ in all stages of development. The Coccidæ also increase in number, so that the cavity of the petiole sometimes becomes crowded with inmates. The beetles solicit honey dew from the coccids by "stroking" the latter by means of the antennæ. When the old beetles die off, their bodies are consigned to refuse accumulations. When this crowded condition is reached, beetles leave the colony either singly or in pairs and, seeking other petioles, thus found new colonies.

Our Psychic Investigation in Europe—I

Interesting Psychological and Physical Phenomena Observed at a Sitting with a Scotch Medium

By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

ACCEPTING the recent invitation of Sir Arthur Conan Doyle to visit the psychic centers of Europe, we dispatched Mr. J. Malcolm Bird, our Associate Editor and Secretary to the judges of our psychic contest, to England. Mr. Bird sailed on February 10th last, and absolute secrecy was maintained with regard to his trip and his mission in order to facilitate his investigation abroad. The first and second seances attended by Mr. Bird, under the auspices of Sir Arthur, are reported in the accompanying article. After investigating the leading available British mediums, Mr. Bird will go to France to study the work of Dr. Richet, Dr. Geley and other French workers at first hand, followed by a visit to Munich, where Willies S., under the watchful eye of Baron von Schrenck Notzing, has exhibited what are reported to be unusual psychic powers. Mr. Bird's observations and deductions will be published in our columns in regular order. Meanwhile, this investigation abroad in no way interferes with the work of our judges and psychic committee in this country. *See editorial on page 300.*—THE EDITOR.

FROM a variety of causes too numerous to catalog here, instead of arriving in London on Monday, February 19, as had been expected, I reached there only at midnight on Wednesday, the 21st. After Sir Arthur Conan Doyle and Mr. Engholm of the editorial staff of *Light*, the London spiritualist organ, were aware of my being in town, they arranged for me to attend a seance by Mr. A at a prominent psychic center in London on the evening of February 23.

The medium turned out to be a short, stoop-shouldered Scot, quite taciturn and with a fairly noticeable burr in his speech when he did talk. He was an altogether commonplace person in every detail of appearance, and, so far as I could judge, would grade fairly low in education and general intelligence. I make these uncomplimentary remarks for what they may be worth in connection with the performance that followed; my best judgment would be that both in diction and subject matter, much of the "communicated" material of the seance would be quite beyond the normal ability of the medium.

There were twelve sitters, including the medium—half ladies and half gentlemen. None of them need be mentioned specifically. Of all those present, only one, who was the master of ceremonies so far as the occasion called for one, knew me by name and knew my connection with the SCIENTIFIC AMERICAN. To the others I was introduced merely as Mr. Bird, a friend of Sir Arthur's from the States. The medium expressed a desire to shake hands with all who were to sit. Some of them he knew by name, others not; I was presented to him as "Sir Arthur's friend," without mention of my name or my nationality.

The seance room has, at one side, two pillars several feet out from the wall, with curtains so arranged that the space between these and the wall may be shut off for use as a cabinet. No use was made of this, however, the medium sitting in the open space with the others, and the curtains were not within his reach. I have made a sketch of the general layout of the seance room.

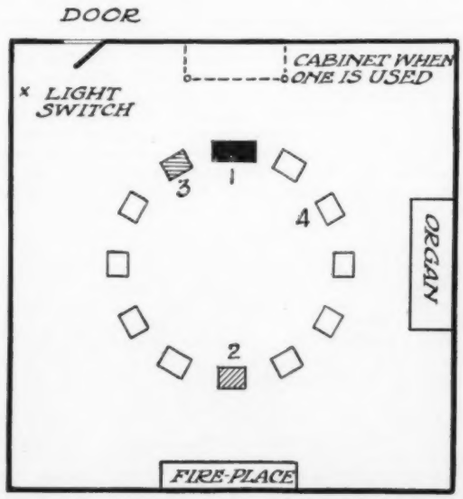
Now the visible properties consisted solely of a long tin horn in two sections, fitting together like a collapsible drinking cup. This horn was brought in by the medium. There was a central chandelier with a group of ordinary white lights, and a single bulb completely covered with red cheese-cloth. These lamps were controlled from a switchboard in one corner of the room, to which one of the ladies had to go whenever a change of lighting was desired. At another side of the room was a small organ. At the side opposite the cabinet space was a fireplace with a dull fire burning in it.

The 11 sitters were assigned places around the circle, ladies and gentlemen alternating, the twelfth place being reserved for the medium. Mr. A, the medium, took his seat at the organ. Suggestions were invited regarding hymns. "Onward Christian Soldiers" was sung, followed by "Lead Kindly Light," and a third with which I was not acquainted. The singing was not done in a manner at all emotional and was, in fact, quite perfunctory; whatever effect it had upon the medium, it could not have had any effect upon the sitters.

At this point I must say a word more about the ladies and the gentlemen who comprised the group. In America one is rather accustomed to finding that the few men one meets at a seance are regular people, but one soon learns to fight shy of the ladies. Almost without exception they are of the "Hermoine" type, dabbling around the edges of intellectual pursuits and deluding themselves into the belief that they are carrying the cultural advancement of the world upon their shoulders; or emotional old ladies who come to have hysterics over their dead; or neurotics of an even more violent sort. There was quite nothing of this rot at the seance of February 23, and I judge that I shall find little or none of it at any British seance. Of course, all those present save myself were spiritualists, who would tell you that they *know* the communications received, and the phenomena noted, come from "those who have passed on." Save for this one point the most violent skeptic can meet them on common ground. There was no emotion whatever at this seance, from beginning to end. There was no mystery or other hocuspocus about it. There was music, presumably to get the medium into trance, and later, darkness to keep him in that condition. Aside from that, it was just an ordinary meeting and conversation between friends.

The most amazing feature of the whole performance was the informality of it. One is accustomed to think of a seance as an event where people sit in the dark with bated breath waiting for something to happen, where silence reigns, broken perhaps by singing and sobbing, until voices come. At this sitting there was no silence and nothing resembling silence. Everybody chattered away gaily with his neighbors, with the "control" and with the "communicators." If we may for the moment adopt the viewpoint of the other ten sitters, the seance was simply an informal gathering of a number of friends, some of them happened to be dead. The voices participated on a footing of absolute equality with the flesh-and-blood guests.

After the three hymns had been sung, the medium became very restless. He arose and resumed his seat at the organ repeatedly, rubbed his hands together loudly, and emitted a series of noises which I was not able to catalog in my own mind. They might have been just weird sounds, and again they might have been incoherent jabbering in Scottish dialect—we all know how the ape in Poe's "Rue Morgue" story reacted upon persons of various nationalities. After a little he attacked the organ for a moment or two without getting any tune out of it; then he circulated about some more; and ultimately he made his way to the seat in the circle that was awaiting him. This was the signal that his "control," White Feather, had taken possession.



The little squares represent the persons attending the seance. The black oblong, 1, represents the chair of the medium, where the medium sat except at such moments as he spent circulating about. 2 represents Mr. Bird's seat at the beginning of the seance, and 3 his final seat to the medium's right. 4 represents the seat of the gentleman who was the master of ceremonies, so far as the occasion called for one

General layout of the seance room

This personality—whatever we believe, I think it fair to call it that—proceeded to speak in broken English that improved as the seance went on. He complained that his "box"—that is, the medium, to whom he thus referred throughout the seance—was not working well tonight. He ordered the red light out, and when this request had been met, he complained about the light from the fireplace. After considerable fumbling in the dark, which did not appear to disturb whatever condition of trance the medium may have been in, a large screen was located and placed in front of the grate, to "Whitey's" intense and audible satisfaction. Whitey continued to conduct the seance, speaking always in the same voice, a rather shrill whine. This voice, of course, quite frankly came from the medium's vocal apparatus. If he was doing it consciously, he ought to be on the thousand-a-week bills, for there was no slightest trace of the Scottish in it, nor in any of the other very different voices that were heard at one time or another during the seance.

White Feather, or Whitey, had quite a rough time with his spirit communicators. They kept crowding, or trying to crowd, one another out, and usurp one another's turns. At times he spoke harshly to them about it. After some time the voices began to come from the trumpet. This had been stood up in the center of the circle. Whether it was picked up in the production of voices, I cannot say. Presently the trumpet gave forth a perfectly distinct sentence. I asked at this point whether both hands of the medium had been held at the moment when the trumpet had spoken so clearly, and was informed that they had. Whitey himself then spoke up and invited me to change seats with the lady at the medium's right. This was done and my hand was grasped firmly and held, with slight interruptions throughout the next stage of the seance. There was no substitution practiced on me here; what I had here was emphatically the large, somewhat hard and altogether rough hand of the medium.

The seance now entered a phase which seems to me to prove without question that telepathy or some other force with intelligence behind it was at work. The trumpet began to talk loudly and distinctly and coherently, in a voice that had not yet been heard. I would insist upon two things here: the voice came from the trumpet in the center of the circle, and I had one of the medium's hands. I take it that, theoretically, the trumpet might have been manipulated by his knees and brought to speaking position next his mouth. We should be able to test this supposition, even in absolute darkness, were the sittings held before our judges and under our test conditions. In any event, it was not ordinary ventriloquism at work, because the ventriloquist cannot work in the dark. He doesn't deceive your ears, but rather your eyes, by directing your attention to the point whence he wishes you to infer that the sound came. When there is no light, you cannot be deceived through the eyes, and your ears tell you the truth. The voice really came from the center of the circle.

The voice announced itself as belonging to one, Cornelius Morgan, whom nobody present knew. After a few remarks of no particular interest he stated most positively that someone was present from a long distance. When I admitted this he named New York as my home. White Feather broke in asking if that were in his country and how far it was from the Rocky Mountains, adding that it was at the foot of these that he lived and that he was a Crow. Cornelius Morgan then resumed and stated, quite categorically and without waste of words, that about three weeks ago, on a Friday at about seven-thirty, I had walked across the Brooklyn Bridge with a lady and a gentleman. This

began to be pretty thick! Since I moved away from Brooklyn eight years ago, I do not suppose I have walked across the bridge half a dozen times. But a week before sailing I had been in New York with an hour or more to spare in the company of two friends who lived in Brooklyn and who were about to start for home. Most certainly I have not walked over the bridge, save on this occasion, within the past year.

I made Cornelius repeat his statement; then I told him that if I were to speak without stopping to think very carefully, I should place the expedition in question on a Saturday, and somewhat earlier than seven-thirty. This drew down severe reproaches upon my head for contemplating the cardinal sin of speech without thought, and quite a bit of repartee passed between the trumpet and myself on this subject. I finally convinced the speaker that it was my best honest opinion of the moment that the facts were with me and not with him, whereupon he insisted with some heat upon his own version, including the gentleman and lady in place of the two gentlemen.

Now it so happens that one of my friends of this walk is a very careful diarist, and he has been asked to verify the date. [Mr. Bird's friend informs us that the walk took place on a Saturday, January 20, a little after four o'clock.—THE EDITOR.]

The mathematical probabilities involved in this communication are not likely the result of mere chance. Certainly, they were not the result of information collected by the medium.

But better was to come. Cornelius stated that I had engaged passage on two ships. This was the truth. During ten days I had staterooms tentatively assigned me on both the "Olympic" and the "Noordam," the former being finally cancelled. Nobody in the world outside of the SCIENTIFIC AMERICAN offices knew that fact, however, while the probability of guesswork is too small to lend color to any such theory. I don't know what this message proves, but it surely proves something. If it be telepathic it proves telepathy can be sub-conscious on the part of the mind that supplies the information, for at that moment I had been thinking of nothing connected with my passage, but rather of the diary which would settle the other question.

But Cornelius Morgan was not through. He turned his attention to another quarter of the circle momentarily, then returned to me, identifying me unmistakably as the gentleman at the medium's right. He said: "Friend, you are a writing man, are you not." That alone I think would have been a mighty shrewd guess; indeed, if one were to recapitulate Sir Arthur's experience with writing men whom he has taken into seances, one might almost guess that the next person introduced by him would surely be a writer! But upon my pleading guilty to this indictment, the voice in the trumpet went on to state that I had been writing something before I came to the seance—a letter, he thought.

I decided it would not be giving him too much of a lead if I informed him that I had been engaged on a letter that morning, but had finished and mailed it. He thereupon insisted that I had been writing *something* before coming to the seance; that I had got up from it to come, and had left it unfinished. This was the literal truth; the paper was still in my portable typewriter, with the half-finished work in it. He did not make any great effort to identify what this work had been, and I did not press him—it would have been unreasonable to do so. The thing really was a list of French words that I wished to add to my speaking vocabulary before venturing upon French soil; and while it would, of course, have been extraordinarily evidential if he had named correctly such an absurd thing, it did not seem to me in the least contra-evidential that he should fail to do so. Surely he came near enough to the facts to bar out any supposition of guesswork, unless, indeed, some hardy skeptic is prepared to include my chambermaid in a gigantic plot to mislead me.

Next he started to talk about some numbers, and Wall Street. We couldn't just make out whether he were telephoning or giving an address, but in any event it meant nothing to me, nor to anybody else present. That was about all we had from Mr. Morgan, save that he asked me if I had ever been to Waupaca, Wis., or Denver. The mention of Denver was followed by that of Riverside, and after I was contradicted in my question whether he meant California, one of the ladies spoke up and identified Riverside as a piece of Denver where she had lived or visited. Nothing further developed.

Cornelius went away, and someone else, unidentified, came in his place. The medium circulated around the group, giving a message to each sitter. Mine was quite trivial. I was confronted with a decision: the one that seemed so rough was the easy one, while the one that looked good was really the rough one. This could be applied to anyone. I repudiated it, whereupon he said something about "crossed currents" and applied it to another member of the group.

While the medium was circling the group, inside the circle of course, we got the first impression of physical phenomena. Phosphorescent lights began to appear, here, there, somewhere else. In each case such a light appeared in the immediate vicinity of the person to whom the message under way at the moment was addressed; but not all the lights were thus restricted to the immediate vicinity where the medium appeared to be. They were of no illuminating power. At first I was puzzled by the fact that usually they were seen by some of the sitters and not by others, the seers and non-seers changing as the light took different positions. Shortly, however, I learned that the reason for this was the very obvious one that the medium is opaque. Most of these lights were small and dim. One of them, which came on the opposite side of the medium to that where I sat, must have been unusually large and bright, for the medium's shoulders were very vaguely silhouetted against it. I should have been satisfied of the objective character of these lights, even had Mr. Engholm, next morning, not informed me that they had been photographed—not at this particular seance, however. The camera had been left open during another seance. In this way the time that would otherwise have been spent opening and closing the shutter was available for making the exposure; and light tracks were got, quite analogous to those of the stars across a fixed plate.

Most of the lights were approximately round, though perhaps a bit longer one way than the other. They gave very definitely the impression of phosphorescence, rather than of flame or filament. I watched carefully for any indication of filament shape, and found none, nor any change of color value as they faded in and out, such as would have been observable had an incandescent lamp been used in their production.

One of these lights stood out above all the others. It came when the medium was, to my almost certain knowledge, holding the hands of the lady opposite me while delivering a message to her. It was a long snaky affair, quite different from all the others, and it moved clear across the circle, from one side to the other, and behind the medium, as I had him located.

The messages delivered during this round of the circle came, some from the medium's lips and some from the trumpet, which up to this time had, with reasonable certainty, remained unmoved in the center of the circle, except for whatever tilting may have been necessary to make it available for messages. Noting this, I centered my attention upon the question whether at any time both types of messages were being delivered simultaneously. As a general thing they certainly were not, though they followed one another very closely. But after my attention had been momentarily distracted by one of the brighter lights, I was rather inclined to believe that during this interval of absorption in another thing I had been vaguely conscious of the double message. It seemed to be in my mind in the form of one of those deferred observations that persist as memories.

The trumpet did considerable traveling, inside the circle, outside, inside again, outside, in more rapid succession than I would care to attempt manually. As far as the medium's reach was concerned, it might have been operated by his hand, but throughout there was black darkness, not merely the darkness of dark nights when near objects loom blacker in the blackness. The trumpet next travelled about the circle, caressing each sitter about the face or head. Some got it endwise; some sidewise. In my own case it would have been quite easy for this caress to have been manually directed by the medium. But I never was able to detect his presence in my vicinity, through contact, hearing, or smelling his breath. If he does move about with such freedom, he has an extraordinary sense in the dark. Our Dr. Carrington has sat with Miss Bessinet, and says that if her phenomena are to be explained on other grounds than psychic powers, then she must be able to see in the dark, or employs a substitute for seeing in the dark. In sittings with Miss Bessinet, one's exploring arm or leg is forcibly seized and forcibly thrust aside and this is done without the slightest suggestion of fumbling in the dark. The hands seize one as cleanly and surely as though in broad daylight.

Now whatever power or sense that enables Miss Bessinet to do this, Mr. A lacks it. While I sat next to him, he must have released and regained my hand or hands a dozen times. Invariably, if I left it where he had dropped it, he came back to pick up my hand again with no fumbling. But invariably if I moved it, he had to find it just as you and I find things in the dark—by groping until he found it. It can not be maintained that the circle is always as he left it—as regards feet and legs at least, it is in a state of constant flux. Yet any moving about the circle which he may be charged with doing secretly, is certainly done without the least suggestion of fumbling or groping. I state this fact without conclusions, for whatever it may seem worth.

After the trumpet performance, White Feather, the "control," apologized for the length of time he had taken and for the difficulty he had had in controlling his communicators. For these occasionally would break through and be rudely routed by White Feather, with considerable abuse.

The next voice was that of the "Director" from the other side. He spoke in very cultured tones, far beyond the medium's normal powers. He offered a very well worded prayer and blessing, which, of course, the medium might have learned by heart. Then White Feather went away, and the lights were turned on.

My aim here, as in future accounts of seances attended, is to tell as accurately as possible what happened at the various seances, and exactly the impression made upon me by them. It is not my intention to draw conclusions at all, save such obvious ones as would occur to any intelligent person during the sitting, but I shall at all times and with the utmost freedom refer to the various hypotheses which have been or may be advanced in the explanation of the phenomena. And I shall at all times remember that among these is that of conscious fraud by the medium. Those of my readers who believe in the medium must not resent the inclusion of this hypothesis, and those who do not believe in him must not make too much of its presence in my story.

It is evident that these British people believe that they are in the presence of friends who come from the other side of the Styx to talk with them. They comport themselves exactly as though these friends had come from the other side of the Atlantic or the Channel or the Thames. From their viewpoint, that is absolutely all there is to a seance. There is no reason for solemnity or stiffness. There is no reason why everybody should hang breathlessly on the words of the communicant. In colloquial American, it is just an ordinary "fanning bee," everybody present, whether

(*Continued on page 358*)

WE have no space to repeat in detail the conditions for our psychic award, published in full in our January issue. For the general convenience, however, we repeat here the more vital points of this announcement.

The SCIENTIFIC AMERICAN will pay $2500 to the first person who produces a psychic photograph, under its test conditions and to the satisfaction of its Committee of Judges.

The SCIENTIFIC AMERICAN will pay $2500 to the first person who produces, under its test conditions and to the satisfaction of its Judges, an objective psychic manifestation of physical character, other than a photograph, and of such sort that permanent instrumental record may be made of its occurrence.

The Committee of Judges shall consist of Dr. William McDougall, Dr. Daniel F. Comstock, Dr. Walter Franklin Prince, Dr. Hereward Carrington, and Houdini, the conjurer. In the event of death or other disability, a temporary or permanent substitute for any Judge may be named.

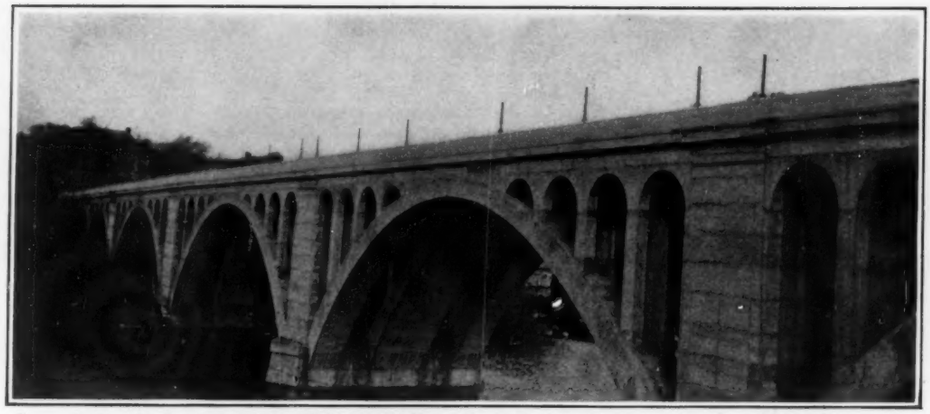
Entry must be made on or before December 31, 1924, to J. Malcolm Bird, Secretary to the Committee, at the SCIENTIFIC AMERICAN office in New York.

Either award will be made on unanimous vote of the Judges, or on a four-to-one division. Seances with any medium shall terminate and all his claims to the award be vacated upon rejection of his mediumship by formal vote of the Committee.

All the conditions governing entrance, the holding of seances, etc., which are laid down in the full announcement of our January issue are part of this offer.

The Georgetown Bridge Over the Potomac

ONE of the finest concrete bridges in the country has recently been completed in the District of Columbia, where it will be used as an improved artery of traffic between the District and Virginia; for it replaces an historic old structure which has served its period of usefulness and has been condemned. The new bridge, which is called the Georgetown Bridge, which with its approaches, is 2700 feet in length, is 70 feet wide and approximately 85 feet above the Potomac River which it spans. The bridge, one of the largest structures of its kind in the United States, provides a central runway for two street car tracks, as well as two sixteen-foot roadways and two walks for pedestrians, each eight feet wide.



General view of the Georgetown Bridge, which was opened to traffic during January, 1923, showing the arch ring built in three separated sections

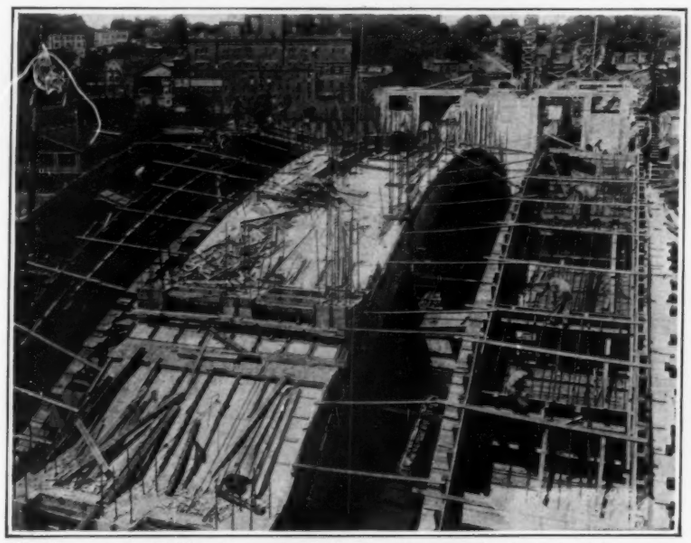
Originally the new bridge was called the Key Bridge in honor of Francis Scott Key, the author of the "Star Spangled Banner"; for Key's old home is located close to the northern approach of the bridge. Years ago, when the famous writer and lawyer lived there, the house was a spacious mansion surrounded by beautiful lawns; but the old home has been neglected, and now it has retrograded into a junk shop. Several campaigns have been started to raise funds to purchase and preserve the home; but they have never developed to a point where enough money was raised to permit of rehabilitation. Despite that, the military authorities who built the bridge intended to call it the Key Bridge; but unfortunately, by special act of Congress in 1918, the name was changed to the Georgetown Bridge.

The old Aqueduct Bridge which the Georgetown Bridge replaces was built 80 years ago. In the early days, Georgetown was a port of considerable prominence and ships from all parts of the world plied the Potomac, with Georgetown as the trade terminal of their commercial activities. Subsequent to the construction of the Chesapeake and Ohio Canal (the artificial waterway which George Washington designed to serve as a channel of easy communication between the Atlantic Coast and the rich inland valleys of Ohio) the Aqueduct Bridge was built, between 1832-1840, to serve as a combined roadway and aqueduct for carrying the canal across the Potomac River at Georgetown. Uncle Sam purchased the aqueduct in 1886 and several years later remodelled the bridge and converted it into an iron deck truss affair. Since that time, it has served as one of the most important highways into Virginia from the District of Columbia.

For several years previous to the inception of the concrete bridge project, the old Aqueduct Bridge had been unsatisfactory. The pier foundations have given considerable trouble and every time much ice has formed in the Potomac there has been great danger that the bridge would be seriously damaged and traffic over this roadway prohibited.

It will be seen from a study of the illustrations that the bridge is thoroughly modern in all respects. In the first place the barrel, or the arch ring, is built in three parallel sections, each of the outer sections being one-half the width of the center section. In this respect the bridge differs from the earlier masonry arches, in which it was customary to build the barrel as one single structure, whatever the width of the bridge might be. The space between the rings at the level of the bridge floor is spanned by reenforced concrete slabs. This method results in a great reduction in the weight of the barrel, and indeed of the whole structure.

Another modern feature is the substitution of a series of spandrel arches for the solid spandrels which characterize early masonry arched construction. These arches are carried upon piers which are erected symmetrically upon the barrel. The arch rings and the spandrel columns are tied together by lateral, reenforced, concrete diaphragms, as shown in the above illustrations.

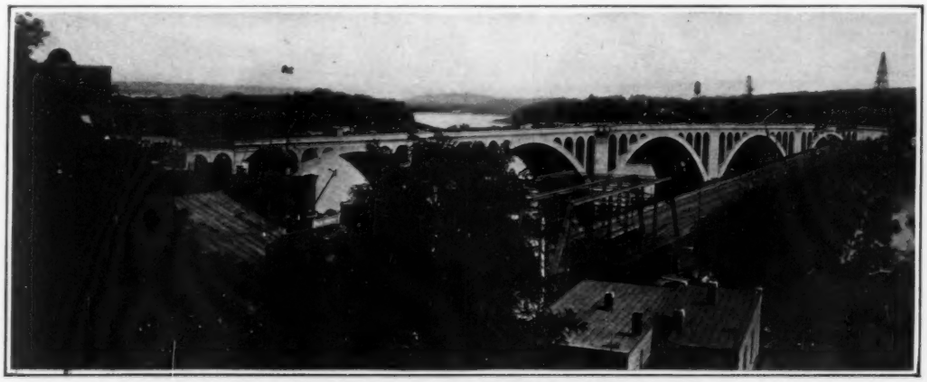


The Georgetown Bridge is constructed on a framework of steel with a maximum of reinforcement to strengthen the concrete

The result of this skeletonizing—if we may so use the term—of the bridge is that a great reduction is made in the dead weight of the structure, and therefore in its cost in materials and labor. In building the bridge, the steel reenforcement arches were erected upon a huge wooden falsework, which was built on two scows fastened side by side, and then floated into place between the piers, when the tide and current were exactly right for such operations. After the steel structural work was in place, the concreting proceeded.

A novel feature was the installation of a complete concrete mixing plant upon a large scow, which was shifted to different points on the line of the bridge as the construction progressed. It was equipped to deliver one cubic yard of concrete a minute to the bridge, and a heavy cable trolley way, which extended between the Virginia and District of Columbia shores, was used to convey the buckets of concrete from the scow concrete plant to the desired spot for pouring.

Work on the bridge began six years ago, when Congress appropriated $2,100,000 for its construction. The work was done under the active supervision of the Corps of Engineers, U. S. A.



General view of the new Georgetown Bridge and the old viaduct which it replaces in conveying traffic across the Potomac

Vitamins

THE discovery of vitamins was made by Hopkins only as recently as 1912. The indispensability of these substances are now generally accepted. The far-reaching importance of the qualitative composition of the diet of man and animals is being gradually appreciated, and the significance of those factors which exist in extremely minute amounts recognized. Three substances of the so-called vitamin class called A, B and C, have been differentiated with certainty, and it is possible that more exist. They do not appear to be of one chemical type, and the only ground for grouping them together is that they occur, and are effective, in very small amounts. Parallel examples from the inorganic food constituents are known, such as the value of minute doses of iodides.

The green tissues of plants would seem to be the chief site of vitamin synthesis, although lower forms of plant life devoid of photocatalytic pigments can apparently produce the vitamin B. Plant tissues undoubtedly form from the direct or indirect source of the vitamin supply of animals, but we are entirely ignorant as to the rôle of the vitamins in the plant itself.

Storage of the vitamin A may take place in the tissues, liver, and body fat of animals, and may serve as a reserve from which are drawn supplies to maintain the vitamin concentration of milk if the diet during the lactation period should be deficient.

A prolonged investigation of the origin of the large stores of vitamin A in cod-liver oils has recently been made. It has been ascertained that the marine diatoms synthesize the vitamin, and that it is transferred to the tissues of minute animals (plankton) which thrive on the unicellular plants. These in turn form the food supply of larger species, particularly small fish, which in their turn are devoured by the larger fish, such as the cod. Through all these stages there is apparently a transference of the vitamin, ending finally in the storage in the liver of the cod. The modern methods of manufacture of cod-liver oil do not appreciably lower the vitamin value, but there are wide variations in the value of different samples which are probably connected with the seasonal changes in the feeding habits or physiological condition of the fish. Considerable work has been done on the chemical nature of the vitamin A, but an isolation has not yet been satisfactorily made.

It is very stable, except to oxidative changes, and passes into the unsaponifiable fraction of the oil. Abstract from an account of a discussion before the British Association, *Nature*, Nov. 11, 1922.

Left: The Million Dollar Causeway connecting Miami and Miami Beach. Note the bridge on right from causeway to one of the islands. The deep water left by the side of the Causeway after rock and sand had been dredged out forms a channel from Miami to the Atlantic for ocean traffic. *Right:* Only 20 per cent of what comes through the pipes is solid matter, yet 10,000 cubic yards can be filled in 24 hours

Islands In the Making

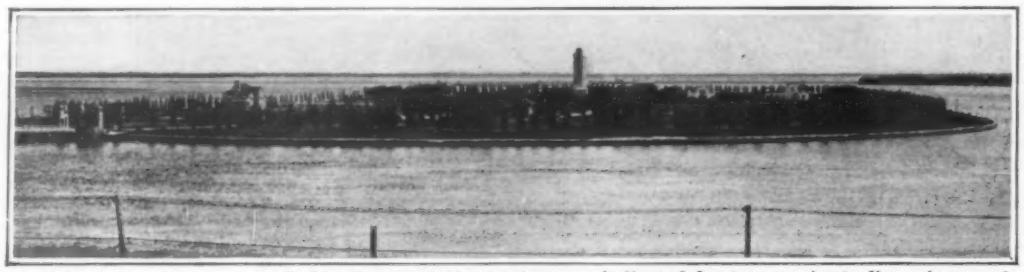
Creating Beautiful Florida Home Sites by Means of Enormous Suction Dredges

THE story of the Coral Islands of the South Seas is well known to all. Ages were needed for the little workers to build those wondrous keys and islands that dot the Caribbean. Less wonderful, perhaps, from an engineering standpoint, but not less interesting, is the story of the islands of Biscayne Bay, eight of which are either complete or under construction.

An island in embryo. From 50 to 60 acres can be filled in six months

This beautiful stretch of water lies opposite Miami on the Southern East Coast of Florida, and is formed by a reef which runs North for several miles, where it joins the mainland. Southward this reef is continued in a series of keys for about twelve miles or so. Opposite Miami the Bay is about three and a half miles wide and is spanned by the famous Million Dollar Causeway connecting the City of Miami with that of Miami Beach, built on the Coral Reef mentioned above, which is about a half mile wide at this point.

To the tourist who comes to Miami to escape the cold and snow, the appearance of an island where the year before he saw only water may not mean a great deal. It means something, however, to those who have in hand the work of building islands.



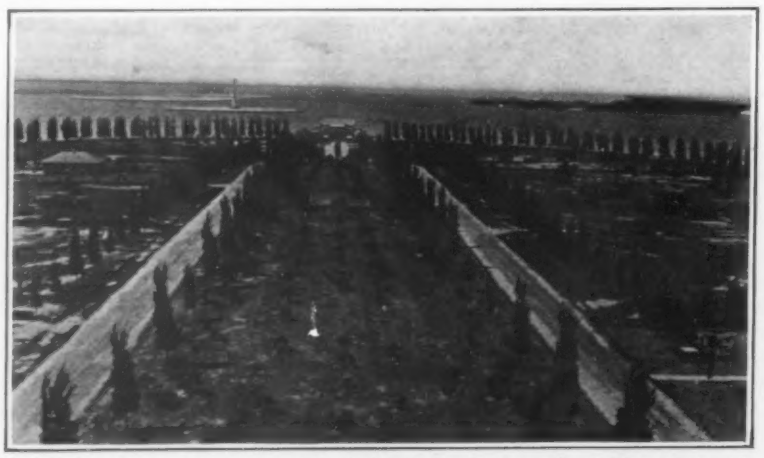
An island after two years. It has its own water system, as indicated by tower. Australian pines and palms soon transform it into a tropical paradise

In the first place, the bay bottom must be purchased from the State at $500 per acre. Next it is necessary to obtain permission from the War Department to fill in. Then comes staking the ground—or water—off, and putting down piling to mark the boundary of the island-to-be. After this the real work begins.

Enormous suction dredges of 1000 to 1500 horsepower are employed, while a crew of as many as 48 men is sometimes necessary to keep things running smoothly. The pipes, 12 to 20 inches in diameter, through which the dredgings are pumped, are laid on pontoons often for the distance of a mile from the dredge to the fill. When dredging in sand, as high as 10,000 cubic yards can be filled in 24 hours, though only 20 per cent of what comes through the pumps is solid matter. Progress is slower, of course, when rock is encountered, but when this happens, the dredge can be moved to a more suitable location. With water 10 to 12 feet deep, 50 to 60 acres can be filled in about six months.

A transformation soon takes place and one of our photographs shows an island two years old. A flourishing community has sprung up, and green grass and trees, streets, sidewalks and every modern convenience induce the homeseeker or investor to pay for a building site in altogether novel and tropical surroundings. Substantial bridges connect with the causeway, as shown in another view, which is also an unique example of work done with both dipper and suction dredges, the deep water by the side of this marine roadway forming a channel to the city of Miami for ocean-going vessels.

Building up islands and filling in marsh lands by means of the suction dredge is not a new idea, however, and use has been made of it in some parts of the country. Nevertheless, in view of the high cost of land, the same idea might be used in many places to good advantage.



View from above of part of an island showing central portion laid out in tennis courts and park. A house and lot on one of these islands recently sold for $65,000

Radio Standardization Conference

DURING the past two years radio communication has grown very rapidly, and radio apparatus and service have developed along many divergent lines. In general, manufacturers have constructed apparatus according to their own ideas, with the result that a great deal of the radio equipment now offered to the public is not interchangeable, that is, the devices of one maker will not work with the equipment furnished by another.

In determining the performance of even simple types of radio apparatus, radio experts often use methods which differ in important respects. Since the consumer demands uniformity and dependability in the radio service and apparatus which he uses, and since even in radio terminology there is great lack of uniformity, there appears to be a real need for radio standardization. The lack of such standardization has been brought to the attention of the Bureau of Standards by purchasers, distributors and consumers.

At the request of six radio organizations, the Bureau, in cooperation with the American Engineering Standards Committee, called a conference on radio standardization which met in New York, January 12. Over 100 persons were present, representing nearly that number of different associations, manufacturers, dealers, and operating companies.

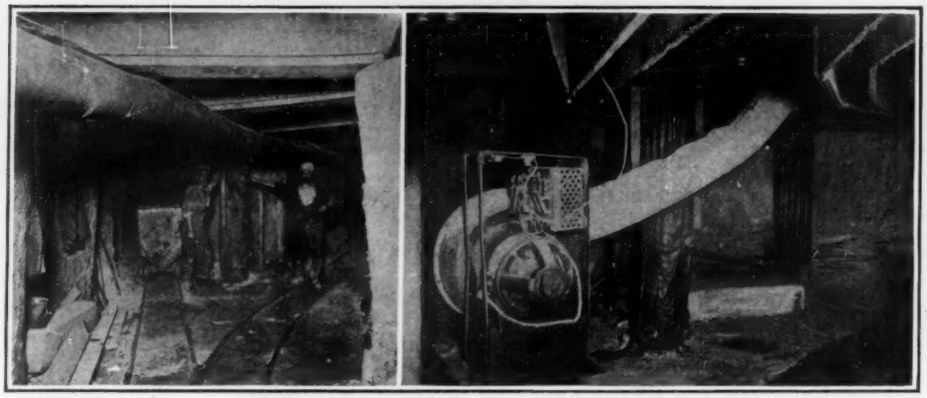
Dr. F. C. Brown, Acting Director of the Bureau of Standards, presided over the conference. Many important points were discussed, and it was voted that action should be taken toward the formulation of standards of radio apparatus and service and that a single broadly representative national committee should be organized following the American Engineering Standards Committee procedure for dealing with all phases of radio standardization, including commercial standardization, methods of measurement and testing, and nomenclature.

It was also voted that the national committee should determine immediately the type and scope of standardization to be undertaken, including a consideration of testing facilities and other related lines of activity. Mr. L. T. Robinson, Secretary of the American Institute of Electrical Engineers, and Dr. A. N. Goldsmith, Secretary of the Institute of Radio Engineers, announced the appointment of an advisory committee of thirteen.

Better Lungs for Miners

MINING engineers have long realized the importance of adequate ventilation as a stimulus to production in underground workings. State laws have increasingly prescribed standards of ventilation. The miners themselves and a friendly public have continually emphasized the physical need for better ventilation in mines.

Thus all conditions have sharply focused the attention of the mining industry upon the subject, long conceded to be an important one.



How fabric ducts are used to circulate air in mines: *Left:* The air duct 2600 feet below the surface. *Right:* A small electric blower with an 8-inch fabric duct

It may be said at once that adequate ventilation cannot be reduced to a simple formula for all the varied conditions of mines and mining. Substantial volumes of pure, well-circulated air must be delivered to all working places underground to secure the economies consequent upon the increased health, comfort and efficiency of the miners and the dissipation of explosive and otherwise dangerous gases. This is accomplished or attempted by widely differing methods.

In coal mines ventilation is almost entirely cared for by surface installations of large input or exhaust fans; by the natural circulation of air through shafts and tunnels communicating with the surface, and by the maintenance of established air courses in connection with brattice and air-tight doors.

The ventilation of metal mines is, however, a very different problem. In some cases there are numerous openings to the surface and fairly good ventilation results, but in most cases this is not so. Air is "pocketed"—stagnant. It becomes vitiated and increasingly heated by the admixture of gases resulting from blasting and from the organic decay of timbering. Heat and gases are also thrown off by sulfide minerals when the ore bodies are exposed to oxidation in the mine atmosphere. In addition there is the accumulation of heat from electrical equipment, from mine fires that occur not infrequently in sulfide ores, and from the natural increase in rock temperature as the depth of workings increases. So the problem of properly ventilating metal mines demands the most careful study by engineers familiar with the specific conditions involved in each case. It requires at least a fair knowledge of that not simple subject, fan engineering, and of the more or less erratic action of air currents under varying conditions.

At the very bottom of the problem, there is always the necessity of providing for the delivery of air in large volumes over long distances, without large losses in transit, and with equipment that is not too expensive to install and keep up and that is entirely dependable in its functioning.

Rectangular wooden ducts were formerly and are still sometimes used for conveying air underground. The initial cost of making and installing these ducts is excessive. Their efficiency is not high, and they are very susceptible to destructive action by fungous growths.

Galvanized iron ducts are also used for conveying air to the working faces, but these ducts are bulky, difficult and expensive to transport, handle and install, and are very liable to collapse from air compression when blasting. Worst of all, they are rapidly corroded and broken down by the acid content of mine waters.

Experience has proved that the ideal air-duct for mines must be flexible, with a strong fabric base. Tubing made of duck and other fabrics, both treated and untreated, has been used for a number of years, but up to within the past two years none of this material could withstand, in the average mine, the rapidly destructive action of fungous growths, and in the case of mines where sulfide ores are found, these fabric ducts were quickly destroyed by the free sulfuric acid in the mine waters.

A determined attack upon the problem, however, recently produced a material that stood up under such accelerated tests as could be provided in the laboratory. Samples of this material were then hung in a drift in one of the large Butte copper mines, on the 1,600-foot level, about 1,000 feet from the shaft. This place was the worst in the mine from all standpoints. The temperature was 112 degrees Fahrenheit; the air was absolutely still and the acid-water drip excessive; conditions were ideal for fungous growth and chemical corrosion. Samples of about one dozen other materials were hung up with these for comparative tests. After three months, of all the samples under test the new fabric was the only material which had not deteriorated. All of the other samples had either completely broken down or were nearly useless.

The Milk-Container Car

WHAT is believed to be a big step forward in the transportation of that most perishable commodity — milk — has made its appearance in the form of the milk-container car. It will be recalled that these columns have already carried a description of the container car system as applied in the handling of freight and mails, and now we have the milk-container variation.

Under the new mode of milk transportation, no icing is necessary and the use of cans, which are handled at a great loss of time and a high labor cost, is eliminated. The new milk-carrying system is the adaptation of the New York Central's container car system to milk hauling, which is accomplished by combining the container car principles with those of temperature maintaining insulation.

The new type milk car consists of nine removable containers, each of which encases a glass-lined heavily insulated tank capable of carrying 645 gallons of milk or the equivalent of 64½ ten-gallon cans. In the entire car, the nine tanks will hold 5,805 gallons, which is considerably more than an ordinary milk car will haul when the milk is loaded in cans.

The new car can be unloaded of all its containers, which are hoisted by crane over to motor trucks, and carried to the milk distributor without any handling in about eighteen minutes, saving approximately two hours per car in time of unloading at railway terminals, thus insuring fresher milk. Milk is received at the same temperature at which it is loaded into the container tanks.

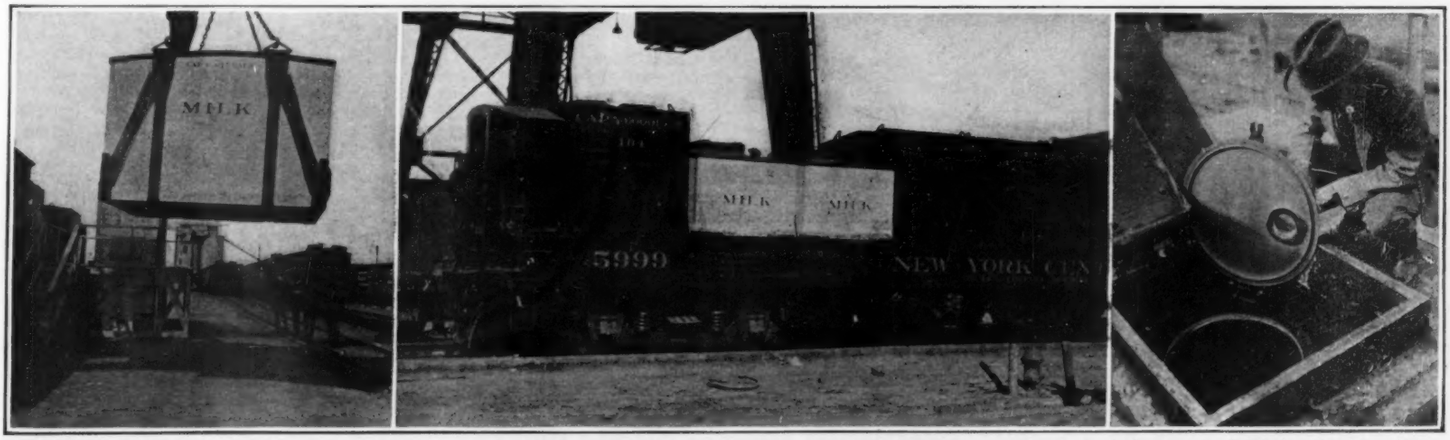
By the elimination of handling of cans and icing the new milk-carrying system will undoubtedly achieve a maximum of sanitation in milk shipping. Shrinkage due to spillage and adherence of milk in handling by cans is reduced to a minimum, as well as cleaning costs, the cleaning of the large tanks being accomplished in five minutes.

The container-tank car consists of nine steel-box compartments which run transversely to the car. Each container houses a glass-lined tank which is insulated by cork between double walls of the compartments. The containers are equipped with hooks or eyelets which permit them to be lifted between car and motor truck by crane.

The glass-lined tank forming the interior of the container has a manhole opening at the top for entrance of the milk. Directly above this (in the container) is located a hatch which is securely locked before the container is hoisted aboard the car. There is an outlet at the bottom of the tank, located directly opposite a small port, which is also locked before the container is placed in transit. The port referred to falls behind the sides of the car when the container is in position, thus making it impossible to manipulate the outlet and remove the tank contents before its removal and unlocking by the consignee.

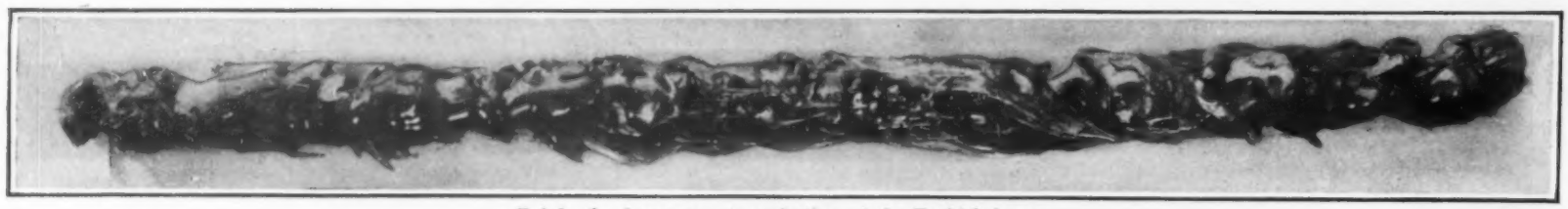
The container cars, constructed for handling milk, are adaptable to the transportation of many other fluids, such as maple syrup, olive oil and vinegar, where service is desirable in 600-gallon units.

Patents on the container-car tank have been issued, or applied for, in the following countries: United States, Canada, England, France, Germany, Norway, Sweden, Holland and Denmark.



Left: Handling 645 gallons of milk in a single container, or the equivalent of 64½ ordinary milk cans. The containers are hoisted from car to motor trucks by crane in slightly less than two minutes. *Center:* The versatility of the New York Central container car system is here illustrated, with milk containers and mail containers on the same car. *Right:* Hatch of a milk container, which gives access to the manhole opening with cover of the inner tank. It is the arrangement of the tank within the container case, plus proper heat insulation, which makes the milk container iceless

A successor to the conventional milk can: the milk container car's bid for the transportation of milk



Zujak, the fragrant nut-confection of the Turkish harem

Foreign Foods in American Cities

Some of the Curious Comestibles that Have Immigrated to Our Shores

By L. Lodian

OF THE confections of the universe, the most luscious is probably the unique zujak of the Turkish harem. This is a nut confection. The little greenish pistachio kernels, or those from sweet almonds or (as in the photograph) walnuts, are strung, then dipped in a vat containing a mixture of steam-prepared vegetable gelatine with the delectable crystalline palm sirup or date sirup (raisin sirup or pomegranate sugar is also used). Dipping is done only when the temperature of the batch is almost at the solidification point, at which moment a few drops of attar of roses are added. These are diffused throughout the mass by a few revolutions of the mechanical ladle, and they are prevented from being diffused into the air by the minimum temperature.

The rose flavor added and properly mixed, the stringed nuts are at once lowered, by the dozen or score strings suspended from a frame, into the vat; lifted out; allowed to dry; and the process is repeated, dip after dip, until the desired thickness of confection coating is deposited on the nuts. This is much the same procedure as that utilized by our New England grandmothers in dipping their old-fashioned tallow candles, in the early days of the Republic. The point strived for is always to have the zujak coating as transparent as possible, so that the nuts are visible and the purchaser knows just what he is buying. They are obtainable at any time in Manhattan's little Turkish republic just north of the Battery.

This is a most sustaining confection food; and the delectable rose fragrance of the zujak suffuses the palate and makes our own confectionery appear commonplace in comparison. Only a little can be used at a time, however; it is too rich.

Almost all the Turkish confections are exceedingly luscious and buttery, and fragrant to a degree unknown to any other race. There is a motive in all this; rich confections are well known to be what medical men term aphrodisiac.

Smoked pears have been for long an institution in what is now the Deutsches Republik. They are produced by the ton in the smoke-chamber or smoke-loft which is part of many a farmhouse chimney in Germany; and they have been exported to America for the past half century or more. Here they always retail at a firm price, about 25 cents a pound.

These smoked pears should be made in this country, to use up the unsalable stocks, such as damaged goods, specks, etc. This is precisely what the German farmer does. Smoking covereth a multitude of defects; the heat-and-smoke-wrinkled pears are almost unrecognizable save for the steam remaining. They are browned through. Here the American farmer has to let them go for stock feed, or worse; and not a single journal of his calling knows enough of the subject to enlighten him.

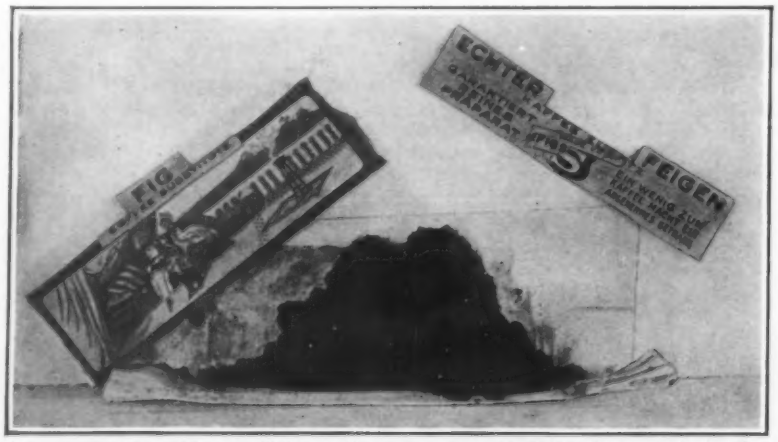
Smoked pears are liked by the Germans for their smoky flavor, just as we esteem ham or bacon for the slight pyrogallic savor. Besides, in obstinate astringency, they are an agreeable "alteratif" or "aperatif," keeping one "just right" as do stewed prunes. In fact, they are stewed and served at their best in their own concentrated boil liquor.

Smoked figs are found in great variety, imported, among Italian colonies in the chief American cities. The most esteemed are the smoked ball-figs—*e.g.*, figs compressed into a ball about the size of the average orange, smoked thus in batches of a hundred, then wrapped in fig leaves for the retail trade.

Smoked raisins are also available from the Naples region. They are retailed packed in grape leaves—always in small packages.

WITH the isolated foreign colonies of our great metropolitan cities, those communities transplanted from Far and Near East and existing in our midst with supreme disregard for their occidental surroundings, Mr. Lodian is perhaps better acquainted than any other person living. He has a fascinating habit of dropping into the editorial office with a huge bundle of exhibits to be photographed, chosen from among his latest purchases. After our camera-man is through with them, Mr. Lodian with characteristic thrift takes them home and consumes them; for were they not made to be eaten? To his cosmopolitan appetite we owe numerous tales of foreign eats, drinks, smokes, etc., obtainable in our midst, of which the present article is the latest.—THE EDITOR.

To know what the original biscuit was like, one must volplane back through a couple of millenia to the days when the Roman legions swayed most of Europe. For the soldiers' sustenance there was devised a breadstuff that would "keep." Ordinary bread would mildew, due to the moisture content; but if it were cut into slices, and these slices placed in the oven again to expel the moisture (bis coctus, twice baked), it would last until it was wanted. Such was the original biscuit.



Compressed-fig coffee, available as beverage or as food, has been made in the Teutonic countries for two centuries. The German label announces the contents as a coffee dilutent (not a substitute), guarantees the product to be pure, and assures the user that "a little bit added to the coffee makes a pleasant drink"

But there was much wastage with these twice-baked slices; in a week, the crumbage alone from a single soldier would form a substantial meal. If we attack a nice crisp piece of toast with a total disregard for table manners, we will get the same effect. So there was devised the small ring-shaped, fit-the-mouth hardtack breadstuff which was baked at a single operation. The word biscuit became a misnomer almost at its beginning; yet it has persisted through the ages.

Italian bakers still make their biscotto hardtack just the same as used in the days of the old Roman Republic. They do not know the biscuit as we know it, though one may see in Italian cities a profusion of small-cake wares which are almost confections.

The Roman biscuit was, and continues, ring-shaped to permit of stringing and hanging up out of the way, or for transport among the soldiers' impedimenta (they could carry their rations around neck or waist, in emergency) in the days when paper bags or cartons were unknown. It remains, even now, the most sustaining and satisfying of all hardtack biscuit wares.

During the strained relations of the past decade in Europe, the French and British armies readopted that small-sized fit-the-mouth hardtack of the Roman conquerors of two thousand years ago, minus, however, the hole for stringing. Thus doth history repeat itself.

Fig coffee has been in use in central Europe the past couple of centuries. It is the only coffee, or coffee substitute, of the globe which can be used either as a beverage or as a nutritive food. It is commonly sold among the Teutonic colonies of American cities in small quarter- or half-pound fit-the-pocket cartons, and is always a compressed cake (though the illustration shows a cake broken up).

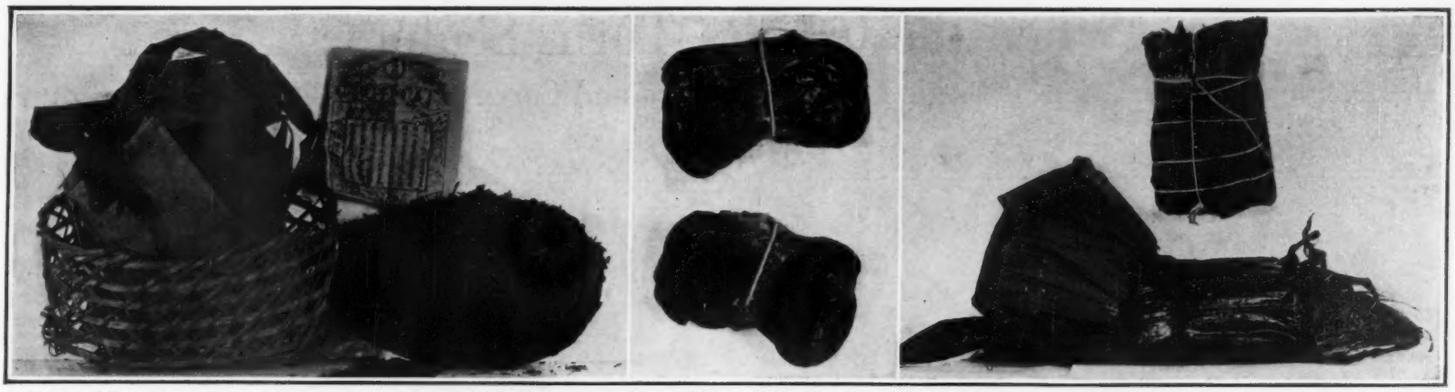
In its manufacture, only the small-fry, unsalable figs are kiln-dried, then roasted, milled to a coarse granular meal, in which the seeds show up almost whole; then compressed into the small oblong cakes familiar to the Germanic retail grocery trade.

As a beverage the infusion is made just the same as ordinary coffee: you break off a piece about the size of a plump walnut or bigger, according to the strength of the infusion desired. This coffee-ersatz is of a figgy flavor, but as a cup that satisfies it is ever inferior to the product from the real coffee bean—and the writer has been familiar with it for the past quarter century, both in the country of its origin and here. There is no coffee-like substitute for coffee, in his estimation.

Figs are quite nutritious—so as an emergency food the fig-coffee has been used by the mountaineers in the Tyrol almost since its first manufacture—and one Austrian concern claims on its label to have been putting it out continuously since 1806. It is eaten as it is—breaking off small pieces as one might a cake or a biscuit. The flavor is slightly bitterish, caramel-like; and in extremity a couple of the fig-coffee compressed cakes will support an adult for a day.

To illustrate the tamal family of the universe (this is the correct spelling and pronunciation, the *e* being in place in the Spanish plural tamales only), we select the oldest known type—the rice-tamal of the Mongols. The word tamal is of Oriental origin, and not from Latin America as the dictionaries allege. This rice-tamal is a fresh-daily product of the Oriental food bazars both here and on the far side of the Pacific. It is steamed in the rush leaves, as illustrated. To make more tasty the insipid rice, it is associated with a portion of ripened egg; and the flavor indeed reminds one somewhat of the odor of the sulfureted hydrogen from which the "ripened" egg derives its distinction. Still, it is a satisfying tamal.

A satisfactory Oriental tamal is made like a miniature



Left: One of the numerous forms of compressed tea. *Center:* Dried duck's gizzards—a Mongol delicacy. *Right:* The oldest of the tamal family—rice tamal as packed in rush leaves by the Chinese, shown opened and closed

Unusual food and drink from Oriental regions

pyramid, of rice, comminuted with pork, piñon nuts and chestnuts. One is enough for a meal. The rush leaves in which it is steam-cooked will preserve it for months, if need be; but placed in a cool dry place it gradually hardens without molding, and can be resurrected by water-soaking and heating.

The tamal family south of the Rio Grande consists of the well-known maize-and-meat tamal put up in maize husks; and in the region on the Orinoco and the Amazon we find the biggest tamal of the two worlds—so big that the accommodating leaves of the banana tree are requisitioned for holding it. The native name for this tamal is aliaka. It is a choice combination of maize meal, minced chicken, chick peas, with more or less of warmth produced by pepper. The whole is thoroughly cooked, done up in the banana leaves, and the package will keep for a long time if suspended by its string in a larder where there is ample circulation of air. Even if it slightly sours, it can be turned out into a stew-pot, boiled vigorously a couple of minutes, which dissipates the sourness, and a most sustaining stew portion is available.

All the compressed teas are firm-priced, retailing at from one to four dollars the pound. They are very different from the economically priced briquetted tea of the moujiks of the Russian Republic; *that* is composed of tea-dust. But of the various brick teas on the Manhattan market, on regular sale among its exotic populations, all are composed of the whole tea leaf, so that the exhausted tea leaves appear the same as the regular loose tea.

A few years ago there was illustrated in these pages the disk form of the compressed whole-leaf tea; and it is also obtainable in slabs, bars, balls the size of golf balls, horseshoes, in tiny faggot-like bundles (leaf and twig being silk-bound in compact rolls, also as an oval, illustrated). This is an Oolong tea—a black tea with a green tea flavor. It is sold in one-pound split-rattan baskets, enmeshed in rush leaves.

Brick teas range in density from those machine-compressed to a stonelike hardness, to the more loosely associated pedal-compressed teas, easily crumbled between the fingers. The latter method of compacting tea is peculiarly Chinese; it is done by the bare feet of Celestial damsels, who do the light fantastic over hundreds of tea-filled molds placed on the floor. However, even that is hardly as bad as the foot-pressed European choice wines of the most exclusive clubs. I have pictures handy revealing this mode of expression of the grape juice in continental Europe.

Loose tea is a bulky article. The compressed varieties can be tucked away in your coat pocket, a three-pound slab being unnoticeable—save for its weight—in the inner breast pocket. Try to do likewise with a three-pound package of the loose product, and the utility of the compressed for persons who travel will be apparent.

Gotham's queer polyglot gizzard—or gullet—is appeased, in part, by the imported sun-dried gizzards always on sale in Oriental stores, particularly in those of Manhattan's little Chinese Republic. These are ducks' gizzards, and they are always in demand at good prices.

Gizzards are of high protein value, and no meat product of Chicago can surpass them on that score, weight for weight. Of the many queer animal foods consumed by the alien colonies of the city along the Hudson these gizzards are perhaps the last word. They are horny, and call for much soaking and boiling.

As a vegetable partner for the gizzard dish there is the elongated water-lily root. These are heavy tubers and, as sold, look for all the world like plump bananas growing end to end in a chain about a yard long. Only the Oriental stomach can appreciate them.

The Mongol food-world is a seemingly endless succession of curiosities: from braised canned earth-worms to luscious white strawberries; from bean macaroni to pure bean casein cheese, a most tasty, snappy product; from shark fins at $5 a pound to birds' nests at $25; from snow-white rice-biscuits to delectable rose-flower marmalade, the opening of a container of which will suffuse a room with the rose odor; from pure buckwheat noodles to blanc-mange pastry made from the flour milled from water-lily bulbs; from ripened eggs to dried oysters; from rainbow-colored cake wares to—well, as a Mongol said to the writer, "Our republic is so vast—the greatest in land area of the globe—that no Chinese citizen knows other than a small part of its food products."

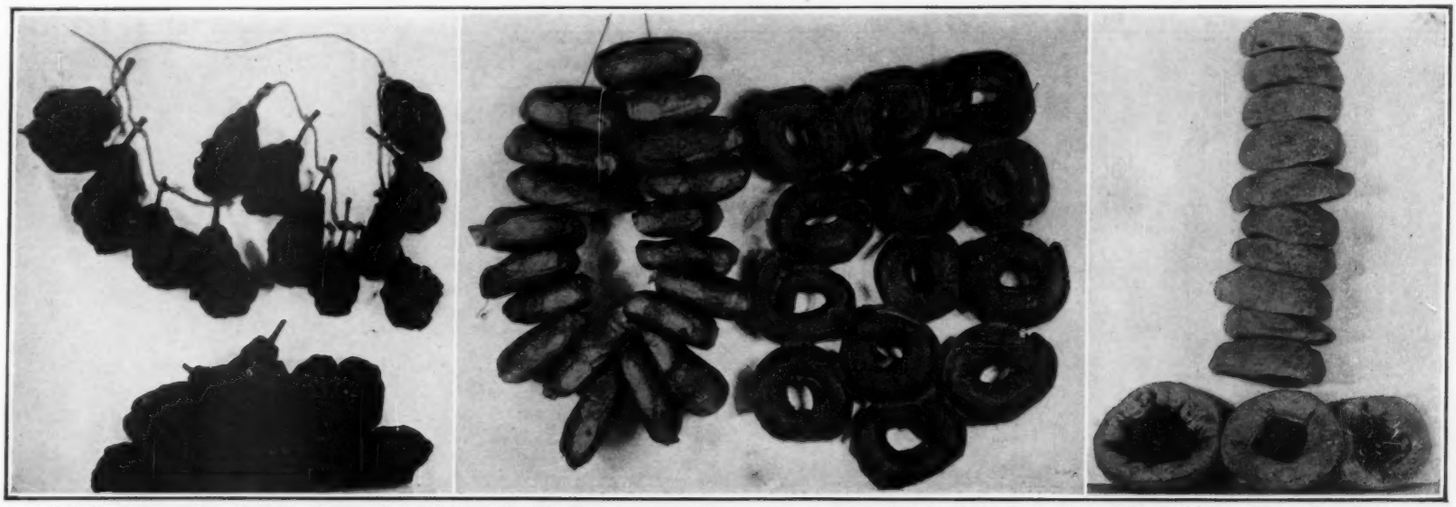
The thing that Americans in Nippon facetiously term Japanese mushroom fruit is none other than the sun-dried persimmon. They provokingly resemble, in this state, the mushroom of commerce. They are of slightly figgy flavor, but less sweet, and too hard to be satisfactorily mouthed as they are; so they appear at table stewed in their own juice, and are thus quite delectable.

The potted stewed snails of the Spanish colonies are obtainable, but are not illustrated, as there is nothing to show except the can label depicting the live snails climbing a bush-twig.

To anticipate inquiries, it should be noted that any curiosity seekers investigating the foods of the nations can always obtain them by a little trip through the alien colonies of big cities like New York or Boston or St. Louis; or even in a smaller metropolis like Seattle, Cincinnati, Minneapolis or St. Paul. A police officer will be able to locate such colonies for the inquirer.

In New York, for instance, are found the compact colonies of the several alien peoples, demarcated, generally, by only the width of a single building from the rest of the city, yet preserving to a remarkable degree their own entity and tongue. Emerging unexpectedly into one of these Old-World islands, one becomes aware of the quaint little foreign foodshops which display their stuffs in the windows, enticing one inside where the exotic odors of a world of fantastic edibles assails the nostrils.

About a dozen articles have now been printed under the author's signature describing and illustrating the more remarkable and featureful foods of all nations in daily use among the foreign colonies of the American cities; and there are still a few hundred of these food freaks which might be rounded up, and many of them more grotesque than those already half-toned. The series, no matter to what lengths it were stretched, could only give an idea that the world has a queer stomach.



Left: Smoked pears from Germany. *Center:* The original biscuit of the Roman armies of 2000 years ago, as it is still made. *Right:* Not mushrooms, merely dried persimmons from Japan

Further proof that one-half the world never knows what the other half eats

When the Camera Turns Sculptor

An Ingenious Combination of Magic Lantern, Camera and Carving Machine for Photo-Sculpture

By P. J. Risdon

THE newly discovered method of photo-sculpture, to be presently described, has outraged the artistic instincts of certain sculptors, much as photography upset the equilibrium of the artist painter. But although "art for art's sake" is an excellent motto for the artist, it is never likely to appeal very strongly to the general public; and if mechanical means assist towards equally faithful representation at less cost and trouble, they will be welcomed by the great majority. As well might it be contended that there is no real music except that of the human voice—indeed the writer was once solemnly assured by a religious and musically inclined person that he objected to an organ in a place of worship on the ground that it was not music and amounted to praising the Almighty by machinery.

Left: **The drill of the carving machine, with partly carved work on the head stock.** ***Right:*** **A guide plate on the rotating carrier of the carving machine, with microscope above**

Reverting to the subject of pictures: it may not be generally known that some perfectly genuine portraits are painted in the following manner: An artist, having secured a photograph of his patron, projects it to the required scale, with the aid of a magic lantern. By this means he is enabled to produce, with a minimum amount of trouble, a life-like portrait, only needing to see his client for a few minutes when putting on the finishing touches. Incidentally, the method saves the patron much time and trouble, and results in a truer portrait, especially in the case of young children, although probably there will always be people willing to pay big prices for an artist's name and for no better a result than by the usual method.

It is with the help of photography, on more complicated lines, that Howard M. Edmunds, of England, has evolved his system of photo-sculpture by means of which faithful and accurate reproductions may be executed either in relief or intaglio, of any object that comes within a sculptor's range of work. Moreover, such reproductions can be worked in any required material—wood, ivory, marble or metal, in any degree of relief and to any desired scale (within limits), the correct proportion being maintained in all cases. The actual carving is done by means of a mechanically operated cutter or drill, and it is perhaps not unnatural that sculptors should at first be up in arms against it on the score that it is a purely mechanical process. Nevertheless, as the inventor points out, the method is no more likely to militate against the real art of sculpture than photography did against the sister art. So far from it, just as photography has brought to millions the enjoyment of portraits, scenes and events otherwise denied them, so photo-sculpture may serve to bring before the public beautiful examples of work that may serve to educate and to arouse an interest hitherto unfelt in the sculptor's art.

The process under consideration is briefly described by Mr. Edmunds, Sr., as follows: "In a dark room, light from a magic lantern is projected on to the face of the subject through a screen of glass upon which is a series of lines in a spiral form—something like a gramophone record. These lines, falling on a plane surface, would show as a uniform spiral, but when projected on to a human face, for example, they become irregular and distorted. A photographic camera at the same time receives on its sensitive plate the object before it, with all its distorted lines. This plate is fixed and developed, thus furnishing the 'record' which is afterwards employed in the carving machine, enabling the operator, by carefully following these lines, to control a revolving cutter, or drill, which effects a cut of varying depth in the material upon which it is acting, and thus produces a solid copy in the three dimensions—length, breadth and height—of the subject upon which the lantern has thrown its rays."

It should be here mentioned that there is no particular magic about spiral lines. Parallel lines would serve the purpose, but the inventor happened to choose the spiral, to which his first machine was adapted. In either case the fineness of the work depends upon the closeness of the lines. With 100 lines to the inch the grooves in the carving are scarcely noticeable, just as a half-tone reproduction appears like a photograph, the dots being unnoticeable. The closer the lines the finer the finish, but the longer the time taken.

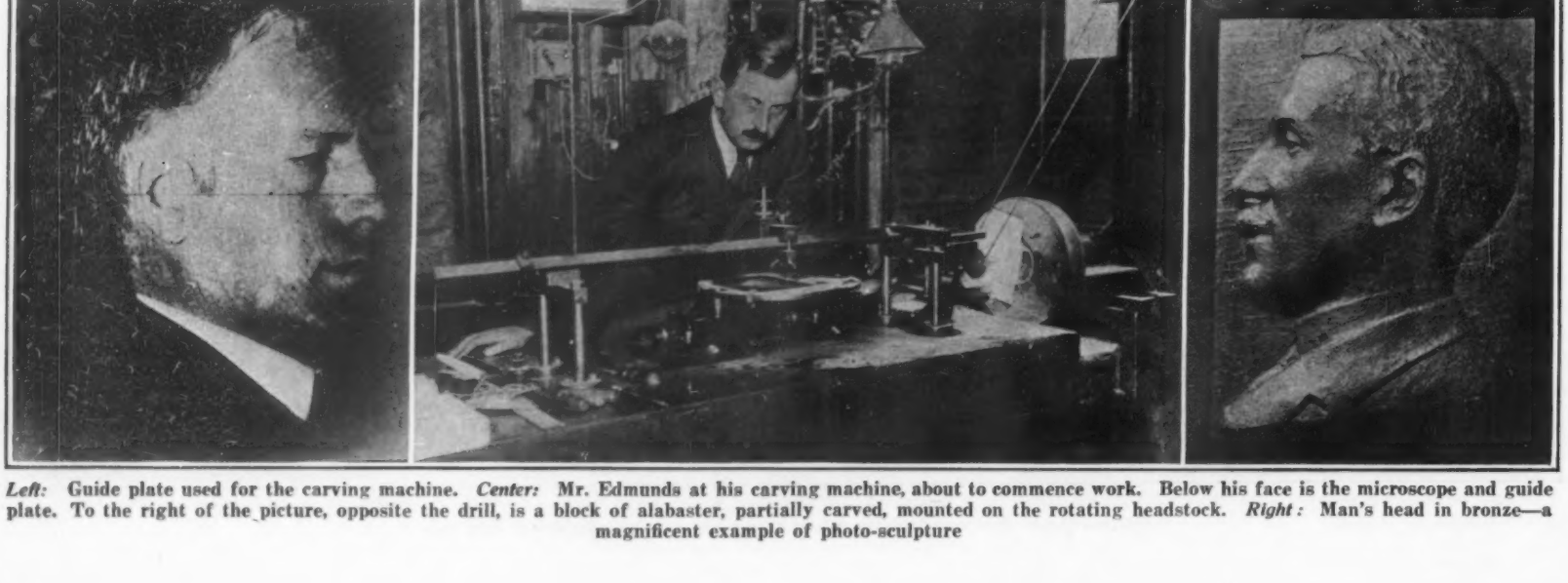
Before attempting to follow the process in detail it is essential to understand the principle on which it is based. In photographing an image on a plane surface, such as a picture, the plane surface is usually arranged parallel with the plate of the camera; *i. e.*, at right angles to the axis of the lens, and with the lens facing the center of the picture, although it is not essential that it should be central. If, however, the picture be placed so that it is no longer parallel with the plate of the camera, a foreshortened reproduction will be the result, the distortion increasing with the angle of tilt. If we substitute a magic lantern for the camera, and interpose a glass plate marked with spiral lines, the lines will appear truly spiral on the picture, and if the camera plate be placed at an angle to the plane of the paper and a photograph taken, the lines will appear distorted in such a photograph. But by projecting the image again onto a screen at a correcting angle the original undistorted image would appear.

If instead of a plane surface an irregular object, such as a human face, be substituted, the image of the spiral lines, if viewed from the projector lens, would appear regularly spaced, but viewed from any other point would appear displaced according to the degree of relief and depth of the features. And if a camera be placed with its lens in the same nodal plane as the projector lens, the displacements will follow a definite law which can be mathematically proved, all points on the lines of the undistorted figure appearing to move to their displaced positions along parallel lines.

The lines on the glass screen having been focussed upon the face of the subject, a photograph is taken at an angle and an enlargement to a suitable scale is made on glass—preferably opal glass, as this does not alter its form on development as would be the case if bromide paper were used. Certain corrections are also made, the exact nature and purpose of which the inventor does not at present wish published.

The enlarged photograph on the opal plate is known

(*Continued on page 359*)



Left: **Guide plate used for the carving machine.** ***Center:*** **Mr. Edmunds at his carving machine, about to commence work. Below his face is the microscope and guide plate. To the right of the picture, opposite the drill, is a block of alabaster, partially carved, mounted on the rotating headstock.** ***Right:*** **Man's head in bronze—a magnificent example of photo-sculpture**

Left: How the various sections of the new German iron-concrete safe are assembled into one compact iron-concrete block. *Center:* A graphic proof of the portability of the sectional safe. The man here shown is carrying a single iron-concrete section. *Right:* How the inner strong-box or cash-box, with its door, fits into the outer shell or section of iron-concrete construction

An ingenious combination of iron and concrete in sectional form for the small safe

Sectional Safes of Concrete and Iron

A NECESSARY development in the design of safe deposit vaults for large banking houses has been the provision of safety compartments protected by iron concrete, a material which is invulnerable both to fire and drilling. The vulnerable part of the usual installations has been the door, against which all attacks have been directed. Iron and steel structures, accessible to the oxy-acetylene burner, no longer afford the required protection; and even in the case of safe deposit vault doors, it has been found advisable to coat them with iron concrete, in order thus to offer any effective resistance. However, in the case of ordinary safes the enormous cost and, even more, the impossibility of transport, has so far prevented this mode of construction from being adopted.

A firm of German engineers, Messrs. Bräuer-Tresor, of Düsseldorf, have, on the same constructive principle, worked out a remarkable scheme of construction for ordinary safes, making them as efficient as the strongest bank vault.

A safe such as this is made up of several outside sections, each of which weighs rather more than 110 pounds, and, accordingly, is readily transportable. The number of sections depends on the depth required; they are, like those of a sectional boiler, slipped over one another, each section comprising a closed iron-armored concrete frame, a substantially armored iron concrete plate at the back, and a similar door section in front. An inside frame, having a cash-box inside, joins these sections into a single compact iron-concrete block, merely by turning some substantial screws at the inside bottom of the cash-box and thus uniting this with the iron-armored rear plate.

The Bräuer safe is of such ingenious design that full security is warranted even after melting all iron and steel parts, all structural iron parts being protected against fire by a concrete coating. The lock is secured in a similar manner. Additional safety can be warranted by providing further internal frames as well as by reenforcing the expanded metal parts.

Inasmuch as the concrete frames are coated with an iron sleeve, the exterior of the safe can be given any design required. This sleeve, at the same time, protects the concrete against any direct attack by the hammer and chisel. Any attempt at cracking this safe would entail an enormous noise, thus reducing its chances to a minimum. Moreover, the safety of an installation is increased continually by providing additional sections of the same type. By changing the installation from day to day without any apparent system, the fire and burglar risk is reduced to a minimum. It is also possible thus to adapt an installation to changing requirements.

The manufacture of an iron concrete safe is much cheaper than that of any iron or steel structure, only 10 to 15 per cent of its weight consisting of iron. In the event of removal, the safe is readily dismantled, thus reducing transport expenses to a minimum. In this manner, the cost of erecting outriggers and tackle may be saved, and the necessity of painfully lowering the safe from a window with risk alike to tackle and safe, not to speak of pedestrians, is avoided.

Phosphorescent Light of Fireflies

EVER since the classic experiments of Langley, the light of the firefly has attracted attention on account of its presumed high efficiency and the hope that we may ultimately be able to produce synthetically substances yielding useful phosphorescent light. Some experiments by Dr. H. E. Ives, show that the brightness of the firefly is about 0.014 lumens per sq. cm. This may appear so low as to be of little practical value in comparison with the brightness of a typical white sky (about 1 lumen per sq. cm.) and it is, of course, far below the brightness of most artificial illuminants. Yet if we could obtain such a steady brightness synthetically, and cover fairly extensive surfaces with the phosphorescent substance, it would be possible to obtain a serviceable illumination. The examination of the distribution of energy in the spectrum of the firefly is attended by great difficulty owing to the feeble nature of the light. Dr. Ives employed two methods, photography with panchromatic plates and "extinction of phosphorescence," and deduced that the radiation is confined between 0.5 and 0.6 u. which is the region of the visible spectrum where perception of light by the eye is most acute.—Abstract from an article, *Journal of The Franklin Institute.*

Hard Teeth on Soft Saws

THE machinery of the big modern sawmill has been brought to a high state of perfection, but as much cannot always be said for the saws themselves. The efficiency of the band saw depends upon the hardness of the teeth; but this hardness is limited by the fact that too hard steel would not stand the continual flexion on the running wheel, without developing cracks. These cracks lead to rupture, with great danger to the mill hands. When the steel is too mild, however, the teeth get blunt too quickly, necessitating too much stoppage for changing saws.

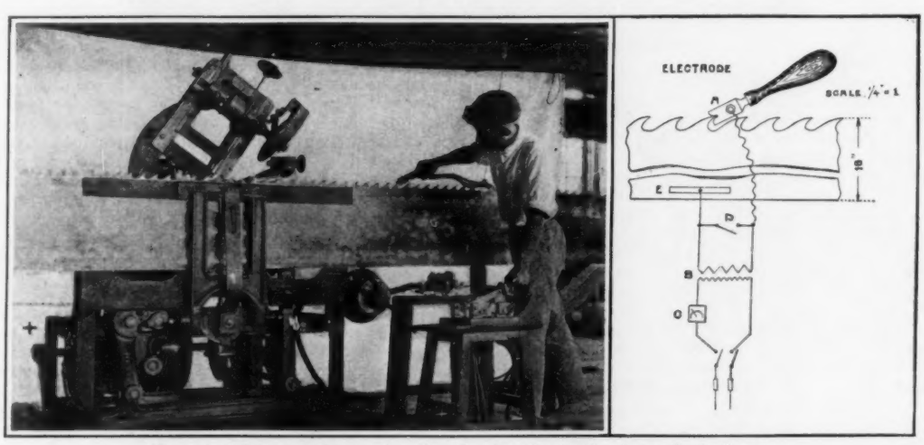
In the effort to reconcile these conflicting requirements, Mr. G. Geerlofs, engineer in charge of a sawmill in Sumatra, has developed a method of hardening the teeth electrically. It is found that the proper procedure is to bring to a glow only the upmost part of the tooth, making it a little more than red hot; as soon as this condition is attained the current is broken and the electrode removed. The local heat is so quickly absorbed by the blade of the saw that no further cooling is required. The extreme point of the tooth is in this way sufficiently hardened to prolong its life very much, while the body of the saw remains soft enough to run around the wheels at speed without damage.

A current of about five volts, alternating or direct, is employed. After every grinding the teeth must be again hardened. The hardness must be so regulated that in swaged teeth no crumbling takes place, so it is absolutely necessary that only the extreme edge of the tooth be treated. This requirement is met by shaping the electrode so that it does not touch the cutting edge of the tooth. Current consumption varies from 170 amperes for 18-gage teeth of 1.24 millimeters, to 565 amperes for No. 1 gage teeth, of 7.69 mm.

In operation, Mr. Geerlof's apparatus works as indicated in the drawing. With the adjustable resistance *C*, voltage and amperage can be easily regulated. The switch *D* on the handle is first closed, short-circuiting the secondary current. The electrode is then put on the tooth, no sparking occurring, of course. Next the switch *D* is opened, a slight sparking of no importance taking place, and the current running through electrode and saw-tooth to the stud *E*, in sliding contact on the saw blade. When the tooth is sufficiently red, the switch *D* is closed again, and the electrode may be removed without sparking. It is absolutely necessary to employ the short-circuiting switch *D* in this manner, because if the full spark of contact making and breaking is permitted, on the saw tooth, the latter will inevitably be burned off. About 400 teeth can be thus hardened in an hour.

Selenium Compounds and Radioactive Soil

THE rare metal selenium, whose chief importance resides in its peculiar sensitiveness to light, as shown by a corresponding variation in electrical resistance, is really not so rare in its occurrence as has been supposed, according to a report made to the French Academy of Sciences by M. I. Stoklasa, who has been studying the subject since 1906. He finds that this element is given off in the fumes of volcanoes and in those resulting from the combustion of coal or pyrites. Selenium compounds also tend to accumulate in the soil from the use of fertilizers containing the sulfate and the superphosphate of ammonia which have been made from sulfuric acid containing selenium as an impurity. The slow oxidation of pyrites, aided by the action of certain microbes, also contaminates the soil with selenium. Both selenites and seleniates, especially of sodium, are highly toxic to plant life. However these poisonous effects are largely neutralized by radioactive substances. M. Stoklasa believes that the well-known favorable effect of radioactive soils on vegetation is largely due to this action.



How electricity can be employed to harden the teeth of a soft steel saw

Left: Summer—fallowing land—plowing the vegetation under and allowing the ground to remain dormant for a season. *Right:* Artificial crop-boosting by means of the manure-spreader

Two fundamentally different ways of adding to the fertility of the soil

Feeding the Soils

What the Farmer Has to Put In to Pay for What He Takes Out

By Arthur L. Dahl

IT IS one of the fundamental laws of nature that for everything we receive something must be given. If Peter doesn't pay, Paul must. Perpetual motion has long been striven for but never attained, because it violates this law. In accounting, for every credit there is a debit, and in electricity there is a positive and a negative. This holds true in everything affecting this mundane sphere.

Our farmers have found that they cannot continue to take food elements out of the soil without replacing them from other sources. As Professor Russell, of the Wisconsin Agricultural College, says: "The soil is the great fundamental asset in our national wealth. Out of it comes life and sustenance for the whole world of nature and mankind. Formerly it was customary to look upon it merely as a mass of inert particles, but we know that it is composed of the most complex materials, and in place of being dead and inert it is pulsing with myriad forms of life. These living organisms act and react, not only on each other, but on the complex soil particles with which they come in contact. If human life is to receive adequate support from the soil, the soil-tiller must feed his soil as he feeds his flocks."

The farmer of olden times applied manure to his fields to improve them, but he did not know exactly why he did it. The modern soil scientists, however, have proved that the soil organisms or bacteria are of prime importance in crop production. These tiny organisms play a most important part in farming. Some species have the power to fix the atmospheric nitrogen and render it available for plants, while others attack the humus or organic matter in the soil and enable the crop to utilize the plant food it contains.

It is a truism that nitrogen and organic matter are the most important factors in the fertility of agricultural soils the world over. Some soils possess more of these elements than others, but even the best are soon depleted if crops are continually grown thereon without some means being taken to replace the food elements extracted by the growing plants. Nitrogen exists everywhere in the air, and there are a number of ways by which it can be made available for the soil. Certain green plants, like alfalfa, cow peas and other legumes, have the ability to draw nitrogen out of the air and store it in the soil, where it is available for plant food for other grain crops. Common barnyard manure, if properly handled, produces a considerable quantity of nitrogenous matter, and in Norway, Germany, and to a limited extent in the United States, nitrogen is extracted from the air by electricity.

To supply the increasing demand for fertilizer the Government recently made a survey of the nation's resources in fertilizer materials, and it was found that in addition to the manure, lime, green cover-crops and other sources directly available on the farm, a large supply of valuable fertilizer could be secured from the garbage of our cities. This waste material contains nitrogen, phosphoric acid and potash, which are recognized as essential to the production of large crops. Valuable as these elements are to the farms of the country, the garbage in which they are found is a source of trouble and expense to the cities. It seems, therefore, that this garbage can be disposed of most advantageously by returning it to the soil in the form of fertilizer.

In cities of 100,000 or more people the reduction of garbage by methods which furnish a residue fit for fertilizer use has proved to be a profitable municipal enterprise, and in smaller communities it might well be made self-sustaining. Numerous analyses of raw garbage show that on the average grease constitutes 3.5 per cent; and of the fertilizer ingredients, potash, 0.3 per cent; bone phosphate, 1 per cent, and nitrogen, in the form of ammonia, 1 per cent. On this basis the value of a ton of raw garbage is about $5, the grease being worth $3 and the fertilizer ingredients $2. Since the grease is of more value than the fertilizer, the reduction process is primarily designed to recover the grease. There are three methods of doing this. The garbage is cooked and steamed and then pressed dry and degreased in gasoline. Or the garbage is dried directly in rotary hot-air kilns and then degreased in gasoline; or it is dried and degreased in one operation.

Grinding limestone for application to sour land

At present only six cities in the United States operate their own reduction plants, and about 20 send their garbage to privately-owned plants. These produce in the course of a year 160,000 tons of tankage, or fertilizer, made from 1,045,000 tons of raw garbage. If all of the 199 cities in the United States which have a population of 30,000 or over should adopt this method of garbage disposal the total yield should be from 637,500 to 937,500 tons of fertilizer each year, worth from $4,780,000 to $7,000,000.

The big packing houses throughout the country also produce large quantities of tankage, or fertilizer, from the refuse of the slaughter houses, and all of this plant food finds a ready market on the farms of the United States. The greatest single source of plant life available for feeding the soils of our farms is in the manure produced on those farms. Through ignorance of its true value, or from improper methods of handling, it has been estimated by the Department of Agriculture that over half of this country's production of manure is not utilized, and the value of this wasted material is in excess of $1,200,000,000 a year, or more than the value of our annual wheat crop.

It has been found that each horse or mule produces annually $27 worth of manure; each head of cattle $20 worth; each hog $8 worth. Calculating from the 1910 census figures for number of animals on farms, the total value of manure produced is found to be about $2,461,000,000, of which only about half is adequately used as fertilizer. Barnyard manure is a very complex substance and undergoes very rapid changes, by which much of its value may be lost if it is not properly cared for. Loss is due to two chief causes. First, fermentation, of which there are two kinds, one of which, for its growth, requires an abundance of air, while the other occurs without air and will die when exposed to it. The first of these ferments is the most active and destructive.

The second source of loss is by leaching or weathering. The leaching occurs more rapidly if the manure is left uncovered and subjected to considerable moisture. On the modern farm, concrete pits are built to store the manure until it is ready to apply on the soil, or often it is spread over the ground daily.

Lime is one of the most valuable minerals applied to agricultural fields, as its application brings about beneficial results in several ways. It stimulates the proper decomposition of the organic matter in the soil, neutralizes acids in the soil, improves the physical condition of heavy soils, supplies lime to growing plants, or makes available other elements in the soil. The great majority of the soils of the east, south and portions of the central west are deficient in lime and will respond in increased yields to application of it.

Carbonate of lime occurs in nature in several forms, of which ordinary limestone and marl are the most common. Marble, chalk, coral, and oyster and clamshells are forms not so widely distributed. All of these forms when properly prepared are suitable for agricultural use.

Limestone is one of the most common of rock formations, and is found in a great many parts of the country. Limestone is prepared for direct agricultural use by grinding or pulverizing, and when so prepared is marketed as ground limestone.

Practically all crop-producing plants require that lime in some form be present in the soils in which they grow, and generally lime is found in all soils to a

(*Continued on page 360*)

Making the Airplane Radiator and Wing in One

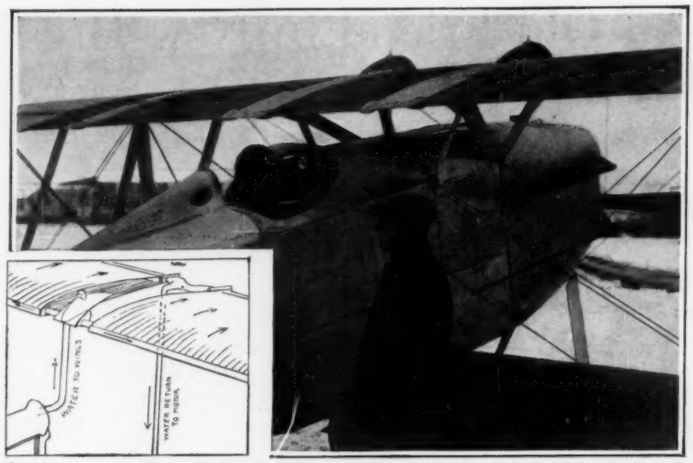
WHAT is said to be the most important improvement ever effected in the radiation system for airplanes is the wing radiator perfected by the Curtiss engineers and used with striking success on the Army-Curtiss planes which took the first four prizes in the national races at Detroit last October. The system is also incorporated in the new military pursuit plane, which is the latest product of the Curtiss experimental factory at Garden City, L. I. This plane, destined for use by the United States Army Air Service, is said to be the fastest and most powerful in the world, with a speed of not less than 160 miles an hour, and other distinctive features which make it especially effective in offensive work.

The wing radiation system, by eliminating the strong head resistance of the ordinary automobile type of radiator, increases the speed of a machine fully 20 per cent. A device connected with the wing radiation serves to regulate the temperature of the oil. One of the problems in pursuit work in the past has been the difficulty of warming up the engine in cold weather. In the ordinary type of machine it was sometimes found impossible in cold weather to get under way in less than 20 minutes. Such a delay, when an attack is imminent, is a serious handicap. The oil radiator developed by the Curtiss Company warms up the engine in a fraction of the time heretofore required and a pursuit plane is able to leave the ground within a few seconds after orders are received.

The wing-covering type of radiator was first conceived and designed by the Curtiss engineer for use on 1920 Gordon Bennett racing machines, but due to lack of time for testing properly it was decided not to attempt their use. Subsequently, other wing radiators were constructed and tested in flight.

During these tests it was found very difficult to remove all air from the water system when filling, this air eventually finding its way into the water jackets of motor and forming steam pockets which ran up pressure on the system so rapidly that the vents were unable to relieve it and as a consequence the radiators were blown up. This trouble was finally overcome by installing a spring safety valve of large area in the water header.

From the performances obtained with the wing radiators on the Curtiss Oriole it was decided to use them on the Curtiss Army racers if an aerodynamic test in the wind tunnel corroborated the belief that their air resistance was negligible. Accordingly, tests were run in the Curtiss wind tunnel at Garden City on various sections and at different velocities, and it was found that there was practically no increase in drag at all over wings without radiators. Curtiss wing type radiators were accordingly installed on the Army racers and later on both of the 1921 Curtiss Navy racers which formerly were equipped with another type radiator. As a check on their efficiency, the 1921 Navy racers, with best previous type radiators, made 186 miles per hour, and with Curtiss wing type radiator, made over 200 miles per hour. The performance of the Curtiss machines in the Pulitzer trophy race when they took first, second, third and fourth place, is the measure of their value. Experiments now in progress indicate that it will be possible to reduce the weight of wing radiators still further.



Curtiss pursuit plane equipped with new wing radiators, indicated by darkened portions of upper wing. Insert shows circulation of water

Low-powered airplane in flight: A result of the recent soaring flight contests

Four-horsepower engine and propeller of the plane shown above

Equipping the Soaring Plane with a Small Engine

THE results of the German gliding contest had the world by the ears during the late summer of 1922. The age-old problem of human flight was brought one step nearer its ideal solution; successful flights of an hour's length were carried out without the agency of a powerful motor, working under high fuel consumption. Keen rivalry was kindled among the nations over the best gliding performance, and within a few weeks after the German record had been hung up, it had been surpassed by a French pilot in the British gliding contest at Itford Hill.

But these very efforts show that the constructor cannot stand pat on the present condition of the art, if he hopes to attain a practical, universally useful technique of gliding. The wholly motorless flier is too severely dependent upon the skill of the pilot and the existence of air currents, ever to come into successful use as a sport and utility plane for the use of everybody. On this account it is appropriate, and has been much urged of late by technical authorities, to combine the experience of the glider and the power-driven plane and build a plane capable of gliding, and which at the same time would enjoy the aid of a small motor of four to six horsepower for climbing and in the absence of favorable currents.

Already the first machine in response to this demand has been offered, by F. Budig, former chief constructor of the Rumpler works. This machine has already shown its value in trial flights. It carries a small, two-cylinder motorcycle motor of four horsepower, with means for cutting it out and in again as the plane glides or ceases to glide.

At the same time this plane shows another interesting novelty, in the form of an automatic longitudinal stabilizer, also developed by Herr Budig after some years of experiment, which is claimed to eliminate absolutely all danger of capsizing in the fore-and-aft direction. In the presence of this device, of course, the pilot would be enabled to give his entire attention to the preservation of his sideways equilibrium. At the same time the learning to operate such a machine would be made easier for less skilled persons. Again, this "automat" serves for greater utilization of horizontal currents, in contrast to the complete dependence upon vertical air movements which has hitherto been the sole reliance of the gliding pilot. The stabilizer is plainly to be recognized in one of our views, at the fore part of the ship. It consists in a rudder surface which is displaced by the changing, waxing and waning gusts, the plane following with the necessary movements for stability and better flight. The plane illustrated can be manufactured by quantity-production methods, at a price hardly exceeding that of a motorcycle. The inventor accordingly hopes that he has what may turn out to be the flivver of the skies.

A study of the two photographs of this power-driven glider will indicate its sturdy construction, which is a prime consideration. Ever since gliding and soaring flights have attracted so much attention, there has been ever-growing apprehension regarding the possible dangers involved in the new sport. The average soaring glider looks so simple that there is a chance of the uninformed building the most flimsy contraptions and then entrusting their lives to crude performances.

An Old Friend in New Dress

The Present Uses for Turkish Boxwood, and the Search for Substitutes

By Samuel J. Record, Professor of Forest Products, Yale University

THERE are certain woods which seem designed to fill some particular niche in man's scheme of things. Just as many words in our language are without synonyms for some of their true meanings, so have certain woods no perfect substitutes for their more exacting uses.

The peculiar resonance property of spruce, for example, makes it unrivaled for sounding-boards of musical instruments. It is hard to conceive how the violin, without spruce for the belly and Pernambuco wood for the bow, could have attained its enviable place in the musical world. Lignum-vitæ alone combines the required density, toughness and natural lubricant for the propeller shaft bearings of steamships. The red cedar is the only perfect pencil wood, walnut the premier gun-stock material, Honduras rosewood the choice for xylophone bars, white pine the ideal matchstick wood, black locust the best for tree nails and insulator pins, white oak for tight cooperage, white ash for baseball bats, shovel handles and bent work, hickory for ax handles, spokes and many other uses where hardness, toughness and resiliency are essentials. All our valuable woods owe their position to some unique feature, some rare property or combination of properties which fit them for special uses where nothing else will serve so well.

And so it is with the Turkish boxwood, the one wood of all the untold thousands in the world that is suited for fine engraving. The properties which fit it for this exacting purpose are light color, extremely fine and uniform texture, the minuteness of its pores, freedom from grit and from splintering, checking, and warping when finished, and a dense structure that lends itself readily to carving and polishing. As John Lyly says in "Euphues and his England," "There is no . . . box so knotty that dipped in oil cannot be carved." For centuries it has held its throne and no pretender is likely ever to overthrow it.

It is obvious that such a wood is eminently fitted for many purposes besides engraving blocks. The list includes mathematical instruments, various carved and turned articles of ornament and utility, weavers' shuttles, mouthpieces of musical instruments, wooden combs, small tool handles, and in the form of veneer for inlay and marquetry, either in natural color or stained. Because of its fine texture and freedom from grit jewelers use wheels of it for burnishing and the sawdust for polishing. Formerly it was much in demand in the manufacture of roller skates, but that day has passed.

If the true boxwood could be had in the size and quantity of our more common woods there is no end of uses to which it could be put. Unfortunately it is at best only a small tree of slow and usually crooked growth and throughout much of its range it is scarcely more than a shrub. Its range is very extensive, covering central and southern Europe, northern and western Asia, and northern Africa. Its commercial distribution is more limited, being much the same as that of Circassian or Persian walnut. The chief source is the region about the Black Sea and the principal port of shipment is Batum, but no stocks have been exported since the beginning of the war. The tree reaches commercial proportions in parts of England, but the English boxwood is inferior to the Turkish.

Considering the circumstances, it is not surprising that the wood has become increasingly more difficult to obtain, the quality poorer and the price dearer. The question of substitutes became acute years ago. The botanical name of the true boxwood is *Buxus sempervirens*, the generic name being the Latin for the box tree and the specific referring to the evergreen foliage. In Cape Colony is another species known as *Buxus Macowani*. In 1885 the wood of this tree was introduced into the European trade as a substitute for Turkish boxwood and has since been known as East London or Cape boxwood. It can be used for engraving, but is not the equal of the other wood. The fact that the tree

"Bois blanc," or San Domingo boxwood, the specimen shown being of unusual height and more regular of trunk than they are ordinarily found

is small, rarely 8 inches in diameter, and of poor timber form, has limited its exploitation. A pile of the wood in the lumber yard looks like rough firewood in the round.

Formerly, nearly all weaver's shuttles were made of Turkish boxwood. Among the first satisfactory substitutes for this purpose were apple and pear wood. The supply of these was so uncertain and inadequate that many others were tried. Of our native woods only two have proved successful, namely, the persimmon and the flowering dogwood, sometimes called American boxwood, and in the English trade known as cornel. Today these two woods supply the bulk of the shuttles used throughout the world.

The making of shuttle blocks or blanks is practically confined to the south, since the industry is so specialized that it can only be conducted successfully in localities where there is a good supply of the timbers. For this reason dogwood and persimmon trees may be much in demand in one locality and without a market in another.

Most of the boxwood now on the market comes from Venezuela and is commonly known as West Indian boxwood. There is record of shipment of this wood as early as 1878, but the extensive development of the business is much more recent. The first wood was called by the natives "amarilla yema de huevo," referring to the resemblance of the color to that of the yolk of an egg. The botanical name of this tree is *Aspidosperma Vargasii*, and it belongs to the same family (Apocynaceæ) as the Knysna boxwood of South Africa. It is almost certain that this wood, often called "amarillo," is produced by more than one species of *Aspidosperma*.

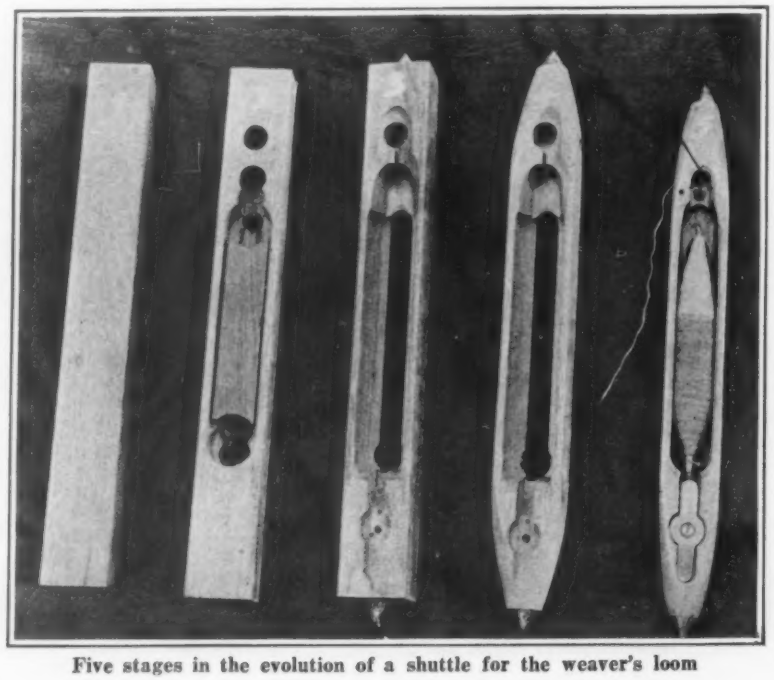
For some reason not clear to the writer the amarillo was soon superseded by another Venezuelan wood, known as "zapatero." For a long time the identity of this tree remained obscure and most works of reference attributed it to *Tecoma* (or *Tabebuia*) *pentaphylla* of the catalpa family. This was a mistake which arose about 1884 due to the incorrect labeling of a specimen in the museum at Kew, England, and remained uncorrected for 30 years. It is now known that the most important West Indian or Venezuelan boxwood is *Cascaria praecox* of the family Samydaceæ.

There seems to be a plentiful supply of this zapatero in Venezuela and the logs are smooth, straight and round, 8 to 12 feet long, and ranging in diameter from 6 to 14 inches at the small end. They are stored in cool dry sheds to prevent bluing, and sometimes they are sawed lengthwise in half to prevent splitting in drying.

This wood is of a light yellow or straw color without any distinct heart. It is of a fine and uniform texture, without distinct grain, and is easy to work or carve. It can be used for all the purposes of Turkish boxwood except the better grade of engravings. It comes the nearest of being a satisfactory substitute of true boxwood of any wood known, and its good timber form and freedom from knots permit manufacture with a minimum of waste.

The most recent addition to the boxwoods of commerce is a wood from Santo Domingo known locally as "baitoa." This first came to the writer's attention in 1918 when a battery commander's ruler made of this wood was submitted for identification. It had two or three features which distinguished it from the other boxwoods, one of which was the presence of lime in the pores in such abundance that when a drop of hydrochloric acid was applied to the end a very noticeable effervescence took place.

Upon visiting the lumber yard of a New York dealer in tropical hardwoods, a large supply of this material was found, but the only information available was that it came from Santo Domingo and was called "baitoa." No reference to this name could be found, and the extensive Yale collections contained no identified specimens of the wood from the West Indies. There were in this collection, however, five specimens of the same or similar wood from Argentina, but at first they served to complicate the problem because the labels did not agree and, in fact, referred the woods to entirely different families. Through a process of elimination, based on some knowledge of the structure of the woods of these families, the writer was convinced that if any name was correct the wood must be a species of *Phyllostylon* in the elm family. It is a far cry from boxwood to elm, but a piece of a twig from an herbarium specimen in the New York



Five stages in the evolution of a shuttle for the weaver's loom

Left: Loading logs under big wheels; pulling the tongue down pulls the logs up. *Right:* Hauling the logs by the big-wheel method; the logs are suspended under the axle by chains

A recently developed apparatus of the logger which makes the old-fashioned skid look like a back number

Botanical Garden established the relationship. Corroborative evidence was later secured from Haiti where the tree is known as "bois blanc," and one more wood has been taken from the "source unknown" list and properly classified.

Regarding the occurrence of this tree in Haiti, Mr. C. D. Mell, who looked it up for the writer, says:

"The 'bois blanc' is one of the most common trees in the dry calcareous regions of the west and north of the island and is said to be most plentiful in the flat and arid regions south of Gonaives in Haiti and on the low dry foothills and lower slopes of the mountains around Puerto Plata in Santo Domingo. Only rarely is it found on the upper slopes and tops of the mountains. It prefers flat lands that are dry and rocky, where it is often found growing thickly in pure forest.

"The crowns of the trees are so open that in the pure stands the sunlight reaches the ground and the trees are accordingly rather short boled. In mixture with other trees casting a denser shade the height is greater and occasional specimens may be seen that are 30 feet to the first large limb and as much as 18 inches in diameter breast high. Usually the trunks are irregular and few of them are suitable for lumber.

"The leaves are small and not very numerous. Every tree, regardless of its site or associates, seems to be full of epiphytic plants which appear to interfere with its development.

"The wood is not esteemed very highly by the natives except for making fence posts and square timbers for buildings of all kinds. Only the smaller sizes are used and the large trees do not seem to be cut for any purpose."

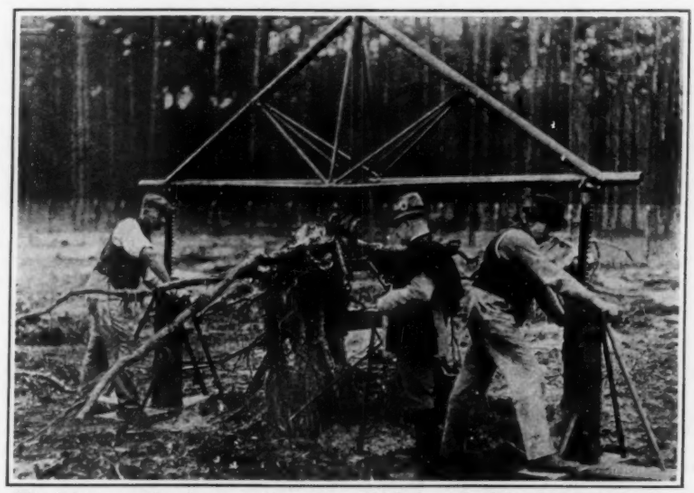
There are several interesting things about this baitoa or San Domingan boxwood. Though it belongs to the elm family, the wood is fine-textured and yellow like boxwood, and the bark and fruit of the tree resemble sugar maple. Only one species, *Phyllostylon braziliensis*, is recognized by botanists, and it is known to occur in Argentina, Brazil, Cuba, Santo Domingo and Haiti. It is proving a very satisfactory shuttle wood, and as the trees grow to large size it is likely to become an important factor in the trade. Through the establishment of its identity several previously unknown sources of supply are made available.

The question of the identity of woods may seem to be of academic interest only, but as a matter of fact it is often of highly practical significance. The native names have such a foreign sound that they are usually discarded by the trade and new ones given. The latter may be purely fanciful, as for instance calling lignum-vitæ "Congo cypress;" but more likely they are intended to convey the idea of a close relationship to some other woods with established reputations. This tends to no end of confusion, may lead to disputes and lawsuits, and calls for expert knowledge to straighten out some of the snarls. It is a common experience for a manufacturer to pick up an odd lot of material that just meets his needs only to find that it has passed through so many hands that its identity and origin are lost. If in all such cases the scientific name can be fixed, the region of growth can be pretty closely determined and old and possibly new sources of supply suggested. Scientific names are recognized the world over and thus provide a key to information regardless of the language in which it is published. Moreover, they indicate natural relationships which are often suggestive to seekers of new woods for old uses.

It is extremely doubtful if the search for boxwood substitutes will ever produce another wood suited for fine engraving. During the present famine of Turkish boxwood stock, block-makers have to practice every possible economy of material. Used blocks are cut into thin layers and glued on to maple backs. In some instances the engravers have had trouble due to the layers being so thin that the grain would tear out under their tools.

In Japan, when large engravings are made, some less expensive wood is used for the main figure, but when the fine details, such as faces and hands, are to be engraved, as indicated by an outline sketch, an inlay of edge-grain boxwood veneer is used.

It might seem that in these days of advanced methods of printing there would be no demand for wood engravings. It is becoming a lost art in this country because of lack of apprentices, though about 200 old engravers remain. Of this number 150 are said to be in Chicago and the remainder in New York. The boxwood blocks are prepared by only two makers, one in each city. The blocks are cut edge-grain so that the engraver works on the cross section of the wood, and are seven-eighths inch high. The best blocks measure 2 by 2 inches free of the pith and can only be procured from logs not less than 4½ inches in diameter. This wood cost $200 a ton in the rough before the war.



The latest machine for uprooting trees, which does the job with great saving of time and labor

Big-Wheel Log Hauling

MANY are the differences between the labors of the lumberjack of yesterday and of today. But in the presence of improved methods of cutting and trimming, it may still be said that the greatest advantage which the lumberman of the present generation has over his predecessor of two or three decades past lies in the immeasurably improved facilities which are offered today for the removal of the felled logs from the forest to the railhead or the water.

There was a time when the log had to be dragged, over more or less effective skids, from the site of its fall to the point where it could be put on the car or in the water or on to the big horse-drawn truck. This was always a good deal of a problem. It is solved effectually and permanently by the big-wheel outfit illustrated herewith. The thing is in principle the same as the straddle truck which has been used with such success in moving large loads of finished boards about the lumber yard; but of course it has to be far more rugged than this comparatively civilized contemporary. It consists essentially of two large wheels, sufficiently rugged for work over the rough forest terrain, connected by a stout axle. Into this axle is inserted a long pole which is clearly shown standing up in our illustration at the left.

Logs—anywhere from one to half a dozen of them, according to size, are suspended under the axle by chains; and their weight promptly tips the pole way up, as shown. But the lack of balance is not a heavy one, and it is comparatively easy to pull the end of the pole down to earth again, raising the logs off the ground as a matter of course. The team of horses or mules is now attached, and serves alike as motive power and counterweight—just as the horse in the shafts of the racing sulky keeps these down to earth at the proper angle. Once harnessed up in this way, it is simplicity to get the logs to the point where they can be dealt with for good.

Jacking Out the Stumps

ONE way to get out the stump of a felled tree is to blast it out. Another is to dig it out. Both procedures have their obvious disadvantages. The machine which we illustrate provides a simple mechanical means of extracting the stump with its manifold roots, much after the fashion which the dentist follows in the extraction of snags from the human jaw. The stump must be of such shape that it can be firmly gripped with chains from above, or failing this, must be excavated until the passage of the chains is a possibility. It is securely moored to the overhead frame, which is then slowly jacked up by means of the two jacks shown at either side; or in extreme cases four of these can be used, one at each corner of a somewhat more ambitious framework. The stump that resists every ordinary leverage will walk right out of the ground under the slow and steady urge of these jacks.

Why Grade Crossing Accidents?

Causes of Automobile Accidents at Grade Crossings as Established by a Railroad's Investigation

By S. R. Winters

THE editor of a national magazine did not mince words recently when, under the title "Grade-Crossing Accidents," he indicted careless automobile drivers in no uncertain terms. He said: "It is obviously of little use to talk of punishment to drivers who take reckless chances at grade crossings, for sooner or later they are killed and their cars utterly destroyed. Unfortunately they usually carry passengers who have no voice in the control of the car and who also lose their lives, because of somebody's mad desire to cross a railroad track ahead of a train."

Abundantly justifying the strong words used in this editorial are the conclusions of a survey recently conducted by the Baltimore & Ohio Railroad Company for the purpose of determining the causes of automobile accidents within the territory through which this transportation system operates. Of outstanding concern is the information that for a period of 12 months, 48 per cent of the injuries and casualties inflicted at railroad crossings are attributed to the failure of drivers of motorized vehicles to halt a few moments until trains have passed over the crossings. In consequence 183 accidents occurred on the Baltimore & Ohio transportation system, exacting a death toll of 35 persons and causing injury to 95 others.

The editor of the national magazine already referred to, in placing responsibility for the growing lists of casualties at railway crossings, suggests a number of faults inherent in the driver, stating that "with something like 10,000,000 cars in service, it is inevitable that thousands of drivers are either careless, too venturesome, deaf, have poor eyesight, or possess one or more of a score of weaknesses which sooner or later lead to accidents." The results of the analysis of the Baltimore & Ohio Railroad Company, however, indicate that if it were possible to drill into the heads of all automobile drivers the futility and foolhardy course of attempting to "beat" trains over crossings, nearly one-half of the accidents which occur would be avoided. The failure of many of the operators of motor cars, recognized by this survey of 183 accidents within 12 months, to determine accurately the rapidity with which fast trains and swiftly moving automobiles approach one another, proved suicidal to the latter. Then, too, the element of chance, which surges in the human breast, impelled some drivers to attempt to "beat" express trains, a gamble with death which almost invariably spelled destruction to automobiles and occupants.

The "stalling" of the engine on railroad tracks is a poor second among the causes responsible for casualties at the seemingly impotent sign, "Stop, Look, and Listen." Eighteen per cent—a sharp decline from the major cause of accidents—of the fatalities and injuries occurring at railroad crossings was assigned to "dead" motors. Eight deaths and 20 injuries were traceable to this cause. The majority of these accidents were brought about from drivers either attempting to change gears while crossing the railway tracks or applying pressure to the foot brake instead of the accelerator. Responsibility for this form of accident, too, is indirectly traceable to the restlessness of the automobile driver who would "take a chance" rather than wait a few moments until the oncoming express train has passed over the crossing. Or, to employ the picturesque terms of the magazine quoted, "Familiarity with any danger breeds contempt."

Gates at railroad crossings are commonly considered as safeguards; yet during the past 12 months this eastern transportation system recorded 50 instances in which automobile drivers blindly ignored the presence of gates and crashed their motorized machines into them. Fortunately, only one person was injured in these half of a hundred mishaps, but escapes from injury were averted by a hair's breadth, as it were. These crossing gates, visible by day because of their alternate white and black stripes, and identified after nightfall by reason of red lights perched thereon, have been frequently destroyed or impaired by careless motorists. Thus, 13 per cent of the grade-crossing accidents are credited to a method wherein at least a measure of protection is offered to the motorist.

This serious railroad accident happened when the driver of a motor truck saw the train coming and tried to beat it across. When on the tracks the driver stepped on the accelerator, causing the truck to jerk forward and spill its load of iron piping on the crossing, derailing the train

When the train, instead of the automobile, is the victim of the grade crossing accident

Ten per cent of the accidents occurring to motor vehicles is ascribed to the attempt of drivers to penetrate railway trains from the side while standing at crossings. "Running into side of trains" is the phrase employed by officials of the Baltimore & Ohio Railroad Company in recounting to the writer the 40 accidents occurring in this manner. Four persons were killed and five injured, because the motorist failed to look sufficiently ahead to see a train buttressed across the pathway. It is almost inconceivable that a person is so careless as to drive an automobile into a railway engine or a string of box cars, yet records offer indisputable evidence of this reckless procedure in at least 40 instances in one year on this eastern transportation system.

Defective brakes on automobiles and too close approach of motor vehicles to the sides of locomotives were causes for six per cent of the mishaps recorded in this analysis of grade-crossing negligence. Eight persons were injured in automobiles because of defective brakes, and five persons were killed and an equal number sustained injuries by reason of "parking" motorized vehicles too close to the railway track. Eight drivers, or about two per cent of those involved in the 183 automobile accidents recognized in this story, were operating machines while under the influence of intoxicating beverages. Four persons were killed and sixteen injured in the automobiles manned by drivers whose insobriety proved in the final analysis to be criminal.

The photograph illustrating this article demonstrates, perhaps, a rare occurrence, and yet one that is not improbable at any time. The driver of the motor truck not only ignored the warning "Stop, Look, and Listen," but stepped on the accelerator with a vim. The result was the motor truck abruptly pressed forward and caused some iron pipe from the truck to "spill" on the railway track in front of an oncoming train. In consequence, not only was the locomotive derailed but the passenger cars were partly overturned, as the photograph shows. The automobile driver was attempting to "beat" a train over the grade crossing. He succeeded. However, his success might be described as well-nigh criminal. The casualty list indicated that the fireman was killed and the engineer and several passengers injured.

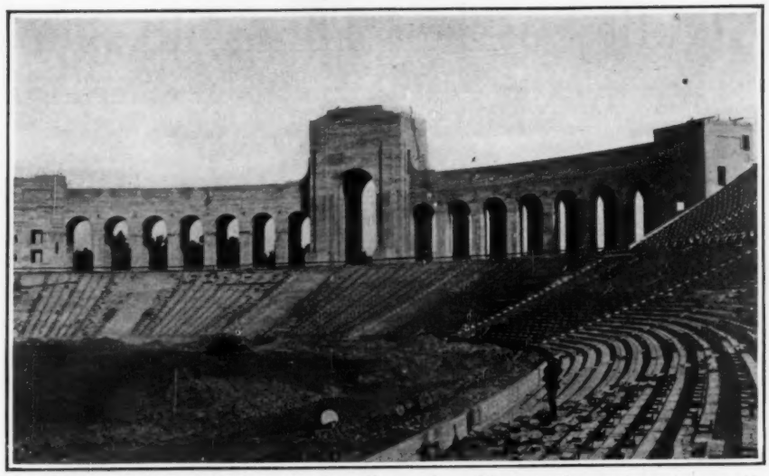
Carbon Formation in Engine Cylinders

"FREEDOM from carbon" has been the war cry not only of the lubricating oil salesman, but of the vender of pistons and piston rings as well. Its appeal lies in the fact that "removing carbon" appears rather frequently in the expense account of the average motorist, and that the need for carbon removal is usually made manifest by a period of extremely poor engine performance. The past few years have witnessed considerable progress in preventing excessive quantities of oils from entering the combustion chamber and the formation of large amounts of carbon from this source is somewhat less common than it was. However, there still appear to be differences in the rate at which carbon accumulates in engines, which cannot be satisfactorily explained through variations in the amount of oil entering the combustion chambers. A possible explanation of some of these differences is furnished by some recent tests made at the Bureau of Standards.

These tests included runs of several hours' duration at full load and at about one-third load. Carbon deposit on the spark plugs was very bad at the low load but negligible at full load. The deposit on the piston head, however, was decidedly worse at full load than at part load. The conclusion, which has been verified in other ways, is that at full load the temperature of the piston is favorable for the formation of carbon while the temperature of the spark plug is too high for such formation. On the other hand, at part load the temperature of the spark plug is favorable for carbon formation and the temperature of the piston head too low. If, in the course of normal engine operation, there are times when portions of the combustion chamber are too hot for carbon to form and other times when they are too cool, it seems reasonable to assume that the rate of carbon formation depends upon the conditions under which the engine is operating, and that there is a certain load at which carbon formation will be a maximum. Likewise there is a certain other load at which it will be a minimum. It would appear, then, that some carbon is bound to form at any one point, and the only remedy is to scrape or burn it off.

The Los Angeles Coliseum—One of the World's Greatest Structures

WITHOUT seeking to establish a world's record, but nevertheless prepared to meet extraordinary demands as far as attendance records are concerned, non-profit organizations in Los Angeles in cooperation with local authorities are now bringing to completion in Los Angeles one of the greatest coliseums in the world. With the addition of a gallery which now appears to be imperative but which was not contemplated in the original plans, this huge structure will have a seating capacity of close to 125,000 people. Without the gallery and without providing seats on the great field in the center, the structure as it stands today will seat 75,000. It is being erected in Exposition Park at a cost of $1,000,000. The architects, John and Donald B. Parkinson, declare that "it is unqualifiedly the greatest structure of its kind in the world."



In addition to 86 tunnel entrances, the coliseum has this imposing main entrance, 40 feet wide and 75 feet high, of concrete and stone

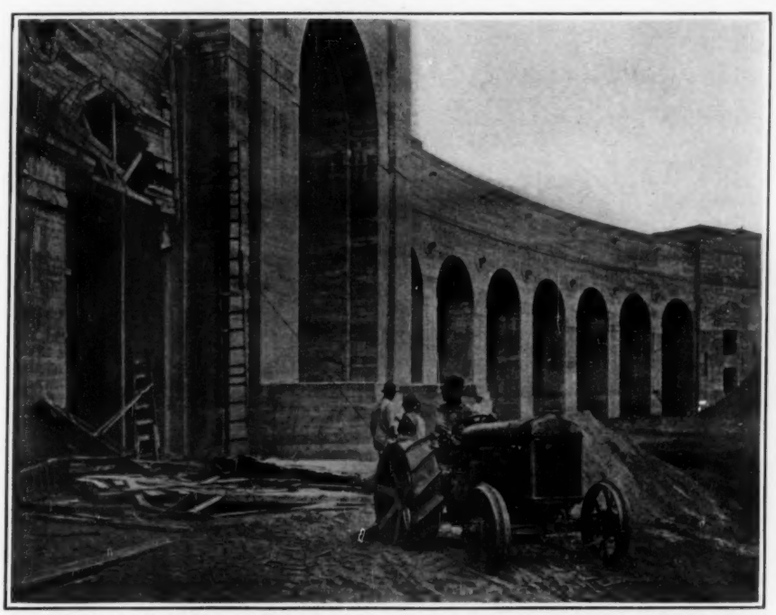
The Los Angeles Coliseum is in the form of a beautiful ellipse, being a combination of an amphitheater and a stadium. It is difficult for the mind to grasp its size, the maximum length being 1125 feet and the width 790 feet. In the center is a playing field adequate to meet every athletic need, measuring 344 by 680 feet. The great structure has been built to meet a need that has become imperative, arising from the great number of outdoor activities and spectacles that are participated in by southern California throughout the year. Pageants, parades, circuses, exhibits and tournaments are among the events already being scheduled for this great recreation center which will be completed in the early part of next year.

Not only because of its size but because of the up-to-the-minute methods employed in meeting the engineering and construction problems of this edifice, is it peculiarly noteworthy. The structure is of the cut and fill type; that is, the central area was excavated to a depth of 37 feet below the natural ground level to provide earth with which to make the banks that rise about the field on all sides. This work involved the moving of no less than 300,000 cubic yards of dirt. It is a remarkable fact that machinery made it possible to move all of this mass with the labor of but six men.

A movable tower 125 feet high was erected in the center of the area that was to be converted to a below-level field. This tower weighed 100 tons and was mounted on rollers so that it could travel a plank path provided for it. From the top of the tower a cable was extended over the area where the excavated dirt was to be deposited. On this table traveled a mammoth scraper, which had a capacity for four tons of earth at a scoopful. As the digging progressed the tower and dragline were moved to new locations until there had been formed a huge elliptical pile of sand and gravel on which the concrete was laid for the exterior of the structure. Penetrating this elliptical wall are 86 tunnel entrances for handling the immense crowds. In addition there is an immense tunnel entering below the level of those just mentioned and opening directly on to the field. It measures 38 feet wide and 28 feet high and affords entrance and egress for parades, performers, etc., the dimensions being sufficient to accommodate the largest floats. The main entrance for the public is a magnificent colonnade or peristyle of concrete and stone 40 feet in width and rising to a height of 75 feet.

The structure is provided with separate buildings for athletic and other performers and will have lights so installed as to permit of performances by night as well as by day.

The erection of this million dollar recreation center is a tribute to the community spirit that obtains in Los Angeles. Owing to certain legal technicalities it was inadvisable for municipal or county authorities to undertake the building of the coliseum. But it was determined that the needed edifice would be built despite restraining court actions, the procedure having been to organize the Community Development Association, a non-profit organization, headed by public spirited citizens. This body entered into an agreement with the city of Los Angeles and the county of Los Angeles, whereby the two latter pay a stated rental for a period of years and have equal rights to occupancy with the association. At the end of the period the coliseum becomes the property jointly of the city and county of Los Angeles.



Close-up view of the huge entrance and the modern method employed in removing the wooden framework into which the concrete has been poured. Note the steel cable by which the tractor displaced whole sides of the mold at one pull

Athletics and Oxygen Supply

IN attempting to analyze the factors which underlie muscular efficiency, most observers have been content to concern themselves with a consideration of the oxygen supply. They have devoted themselves to a study of the means by which fuel arrives at the engine rather than to a study of the behavior of the engine itself. We are now in a position to consider the broad question of athletic capacity from the details of the changes which we know take place in the contraction of an isolated muscle.

We know that during the initial contraction of the muscle and the period in which this contraction is maintained, there is a liberation of lactic acid within the muscle, and that the actual contraction of the muscle is a consequence of the physical forces called into play by the appearance of this acid at various membranes or surfaces within it. The fact of great significance is that these processes in which the full force of the muscle is developed and maintained do not demand for their accomplishment any supply of oxygen whatever. While the muscle relaxes the lactic acid present is neutralized by the supplies of available alkali in the tissues, but not until the period after relaxation is complete does the oxygen consumption of the muscle begin. In this final stage, in which the muscle is apparently at rest, a process goes on which may be compared to the recharging of an accumulator, for not only is oxygen consumed but the lactic acid disappears and heat is developed.

A little reflection is sufficient to help us to realize that the sequence of changes in the isolated single muscle, in which the oxygen consumption only occurs during the final stage, has its counterpart in the processes going on in the body of a man running a race. When the running stops, he is "out of breath," that is to say, he still needs oxygen in excess of his resting requirements, for he does not, from minute to minute during the race, obtain all of the oxygen necessary to oxidize the lactic acid produced in the contractions of his muscles. If he runs slowly the process of removing lactic acid will be correspondingly facilitated, for his oxygen intake will be nearly sufficient to deal with all the lactic acid produced. If, however, he runs quickly, while he does not increase his oxygen, he does increase his lactic acid production, and this production will soon outstrip its removal. In other words, the runner will become fatigued. Fatigue, then, is seen to be due, among other things, to the accumulation of lactic acid in the muscle, and the extent of a man's capacity as an athlete depends on the extent to which he can tolerate such an accumulation. His toleration for lactic acid will depend on the reserve of alkali which his tissues contain for neutralization of this acid.—Abstract from *Nature for October* 28, 1922.

The Influenza Germ

IN *Science* for February 9, 1923, Drs. Peter K. Olitsky and Frederick L. Gates, of the Rockefeller Institute for Medical Research, report the results of four years' experimentation in search of the bacillus responsible for epidemic influenza. They were actuated in this by the fact that competent investigators failed in many cases to find Pfeiffer's bacillus, which has hitherto been blamed for influenza, in either the blood or the nose and throat secretions in the early stages of the disease, although it was frequently found in the pneumonia following the primary infection. They inoculated rabbits with the nasopharyngeal secretions of human patients, and produced characteristic symptoms of the disease. From these rabbits they inoculated others, and from those others, until this had been done fifteen times. Gradually they established the presence of micro-organisms so minute that they passed readily through earthenware filters impervious to ordinary bacteria. They were readily killed by heat at 56 Cent., but they survived drying and freezing, and withstood the action of 50 per cent glycerol for periods up to nine months. By depositing these microbes in the rabbit's lungs, pneumonia was produced in many cases. Meanwhile, the same organisms were being also developed by artificial cultivation, their identity being proved by precisely the same results in rabbits when inoculated. The investigators christened this organism Bacterium pneumosintes. Rabbits into whose blood were injected very small doses of live cultures or of heat-killed organisms, developed specific antibodies against the infection, and became immune to subsequent attacks. A number of officers and privates at the Army Medical School in Washington were later given three subcutaneous injections of killed cultures. Their local and general reactions were milder than those caused by anti-typhoid vaccination, and the blood of nearly all the men promptly developed protective antibodies. On the strength of this, the vaccine is now being more widely used in the army. It would seem justifiable to claim that this bacterium is the incitant of influenza.

The Valley of Ten Thousand Smokes

Short Resume of the Report on the Remarkable Mount Katmai Exploration in Alaska

Photos Copyrighted by National Geographic Society

WE HAVE here a rare tale of the romance of discovery. If there had been no eruption on June 6, 1912, the volume we are reviewing need not have been written; for the story of the "Valley of Ten Thousand Smokes," which was discovered during the exploration, begins with the great volcanic eruption of 1912, which brought it into notice. Exploration undertaken for the scientific study of the effects of the ash-fall led to the discovery of one of the great marvels of the natural world, a place unseen and unsuspected by white man and native alike, until entered by a National Geographic Society Expedition.

Over an area of 50 square miles the ground is all broken open, and hot gases from the molten material below are even now everywhere pouring out, forming the several millions of fumaroles that constitute the "Valley of Ten Thousand Smokes." On the day named above, volcanic ash began to fall over all of northwestern America. Kadiak, in southwestern Alaska, was reported to be the chief sufferer. This remote village is 100 miles from any volcano, so that the actual seat of the disturbance was not settled for a long time, when it was discovered that Katmai had blown up. This volcano was only a dot on a large scale map, and would have escaped attention indefinitely if it had not been for the eruption.

Let us picture to ourselves what would have been the outcome if the eruption had occurred on Manhattan Island. The column of steam could have been seen as far as Albany. The sounds of the explosions would be plainly audible in Chicago; the fumes would have tarnished exposed brass in Denver, and linen hung out to dry would be so eaten by the sulfuric acid content as to fall to pieces on the ironing board. Ash would accumulate in Philadelphia a foot deep. To add to the terrors of the catastrophe, even that city would grope for 60 hours in total darkness—a darkness so impenetrable that a lantern held at arm's length could not be seen. Of the condition of New York perhaps the less said the better. There would be no occasion for rescue work, as there would be no survivors. The whole of Manhattan Island, and an equal area besides, would open in great yawning chasms, and fiery fountains of lava would issue from every crack. The lava in turn would be disrupted by the escaping gases and changed into red hot sand which would consume almost everything in its path. In its deepest parts the molten sand would probably overtop the tallest skyscrapers, though the tip of the Woolworth tower might protrude if its steel supports could endure the fiery furnace surrounding them. For several months no one could approach nearer than Paterson, N. J., or a distance of more than fifteen miles.

With such a fearsome comparison in mind the reader is doubtless prepared for a thrilling story of loss of life. Fortunately there was none, for not a single person perished in the eruption, and we have been enabled to study one of the most interesting examples of geological activity without having to pay the terrible toll of human misery that usually accompanies such cataclysms.

The flow of incandescent sand constitutes an outburst of a new type, different from all recorded eruptions. The phenomena here occurring at the surface, suggest what must have taken place in the formation of many a heavy mineralized region. No less important than the questions of volcanism are the problems of revegetation of the devastated region. The "Valley of Ten Thousand Smokes" is far beyond other volcanic districts in the number of its vents and in the quantity of steam given off. It is well within the truth to say that, except during periods of dangerous eruption, the sum total from all the other volcanoes of the New World is less than is given off continuously within the range of one's vision from the "Valley of Ten Thousand Smokes." The violently explosive eruptions characteristic of the opening stages of the activity have, moreover, entirely passed away. The innumerable vents function as a gigantic safety valve, through which the titanic forces gathered beneath find avenue for harmless escape. There is, therefore, no likelihood of return to a danger condition and the region can be visited with perfect safety.

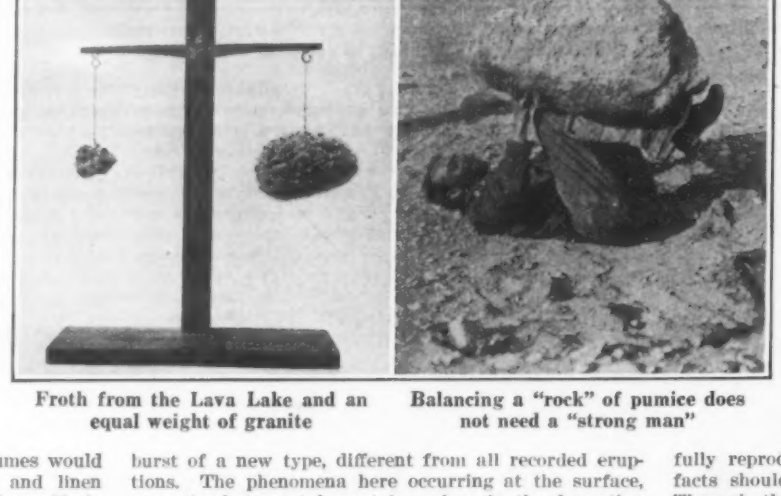
So many natural phenomena of interest to the general public, as well as to the scientist, are exhibited in this remarkable region, that President Wilson paused in the midst of the World War to set aside the whole district as the "Katmai National Monument," which embraces over a million acres. Finally, a new harbor, discovered by the Expedition financed by the National Geographic Society and its members, permits the opening of the region to travel. A few miles of road connecting the harbor with the volcanic area will render the "Valley of Ten Thousand Smokes" as readily accessible as the geysers of the Yellowstone National Park.

Ready as the National Geographic Society always is to reach out for new fields of interest to its members, it is not at all surprising that with the first news of the eruption a representative, George C. Martin, was despatched to the devastated district. The report of this first Katmai Expedition has furnished the basis of the earlier chapters. Prof. F. V. Colville recognized the importance of studying the revegetation of the ash deposits, and Dr. Robert F. Griggs, a soil expert, was selected to carry on the investigation, and it is the latter's book which we are reviewing. Each of the members of the National Geographic Society had an equal share in the financing of the expedition, for a certain proportion of their annual contribution is set aside for exploration purposes.

The volume of 340 pages, which is published by the Society, contains nine maps and 233 illustrations—some in colors; and while written in a popular, or rather a simple style, it does not depart from strictly ethical, scientific principles. It is beautifully reproduced and is a model as to how scientific facts should be laid before the non-technical reader. Through the courtesy of the president, Gilbert Grosvenor, we are enabled to show some of the interesting photographs with which the book is properly illustrated.

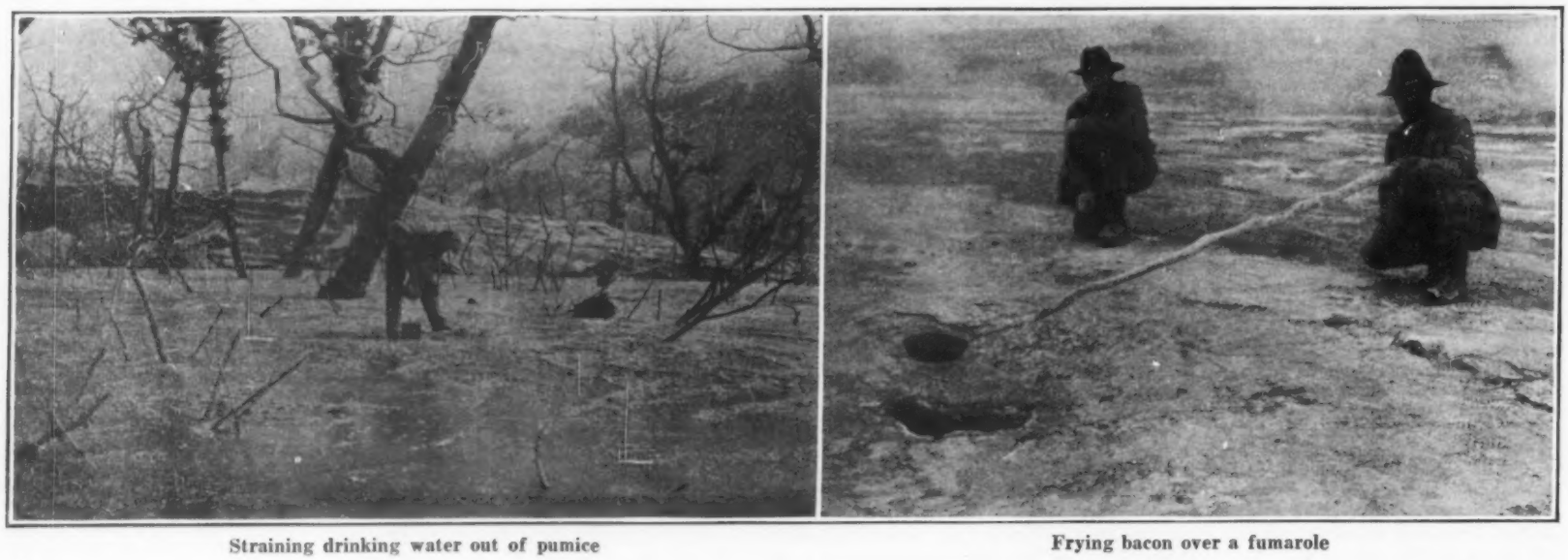
We cannot follow the book through, chapter by chapter, as space is necessarily limited, and we have already given some of the broad facts showing the great extent of the upheaval. The pictures showing the eruption as experienced at Kadiak are most interesting, and we can get an adequate idea of the horrors—mental horrors—from the photograph of the Greek church, with the inhabitants seeking this haven through sinister darkness when the bells boomed out the call to prayer on the morning of the third day. The revenue cutter "Manning" took 500 people on board, although it should have accommodated only 100 people, and the suffering from over-crowding was far worse than that due to the eruption. Everybody was agitated from nervous shock, and they were all in fear of their lives. Finally, the danger subsided and they

(*Continued on page 360*)



Froth from the Lava Lake and an equal weight of granite

Balancing a "rock" of pumice does not need a "strong man"



Straining drinking water out of pumice

Frying bacon over a fumarole

The Handwriting on the Sky—the Most Recent and Compelling Method of Advertising

By Alexander Klemin
Lecturer in Aeronautics, New York University

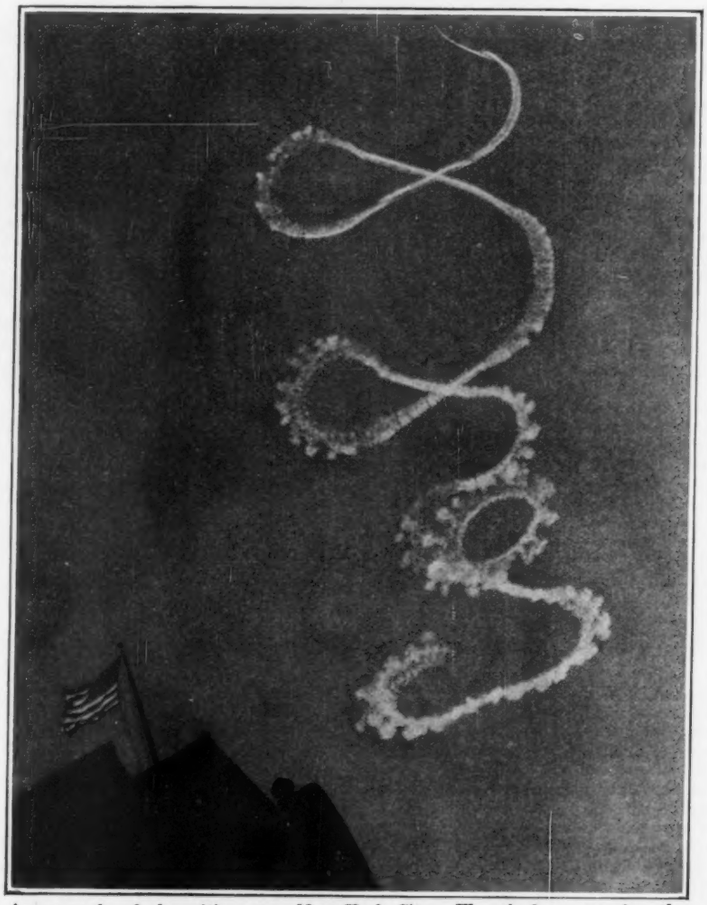
SKYWRITING as a method of advertising has been recently introduced into the United States by an American offshoot of an English company engaged in this work. Gigantic, clear and lasting legends in the sky attract the immediate attention of thousands and indicate the possibility of such advertising being used on a large scale.

The inventor, an Englishman, Major J. C. Savage, conceived the idea of aerial advertising back in the year 1911 when watching in a beautiful evening sky the thin trail of smoke left in the air by the exhaust of an airplane motor. The problem was to generate a vapor which would hang undisturbed in the air and whose emission would be under the complete control of the pilot. Lengthy experiments conducted in secrecy, both in the laboratory and in the air, were interrupted by the war, and a practical realization of the idea was achieved only in the summer of 1920.

The exact chemical process and the control of emission are held secret.

Dr. J. P. Simmons, Professor of Chemistry at New York University suggests, however, that the process is a simple one based on a chemical combination such as that of hydrochloric acid and ammonia, producing a smoke of solid particles of ammonium chloride. An experiment illustrating this can be carried out in the most primitive chemical laboratory. The tank placed in the airplane would have to carry two containers, one of the acid and one of the ammonia, both in liquid form. The tank is connected to the exhaust pipe of the engine, and this pipe is carried to the tail of the airplane so that the emission of vapor is undisturbed. The engine exhaust would provide a draught which would suck on the hydrochloric acid; the vapor of the acid would pass into the second container and mix with the vapor of the ammonia and the resulting ammonium chloride would be carried off into the exhaust pipe. The process could be begun or stopped at the will of the pilot, by working a valve shutting off the apparatus from the exhaust. Possibly another valve would be used to shut off the acid from the air.

A chemical process of this character seems entirely plausible. A combustion process such as used in smoke torches, where pitch is slowly burnt with saltpeter as the oxidizing agent, would be too dangerous even if the combustion were slow and under perfect control, as too great a heat for the comfort of the airplane would be generated. To carry gas under compression would be impossible owing to the enormous amount of vapor used up in the writing. A great deal of beautiful experimentation must have been involved in getting the best chemical process, in regulating the rate of emission, and in getting a vapor which would remain sufficiently coherent in the air to give duration to the skywriting.



An example of skywriting over New York City. The airplane carrying the smoke-producing device is invisible because of its great height

The letters are written in a horizontal plane, with strokes one mile high for the capitals. The smoke trail is circular in cross-section and approximately 50 feet in diameter. The letters of the word "Call" of our photograph are perfectly legible and remain undisturbed in the atmosphere for periods ranging from five minutes to an hour, the average being 15 minutes. About 300,000 cubic feet of gas are required per letter—unless the vapor in the writing is largely diluted by the air, and the apparatus can carry only enough material for the writing of four or five words.

Naturally, somewhat ideal conditions are required for skywriting. The sky must be clear and blue, and the day calm. The writing must be carried out at an altitude of at least ten thousand feet. At this altitude the air is clear of disturbances. There may be steady winds but no gusty disturbances to render flying difficult or to break up the vapor.

The airplane required for skywriting need not differ greatly from the ordinary machine. Only minor modifications are made in the airplane piloted by Captain Cyril Turner, the chief pilot of the firm, such as cutting away a portion of the rudder to give the vapor a free exit. The speed must be as great as possible so that the letters can be quickly written, which enhances the chances of clear writing, and the maneuverability must be perfect. Quick climb to the required altitude and stability are also essential.

Naturally, for work of this kind the pilot must have great skill, attainable only by long training. He has to write upside down, to write straight and legibly, to control both plane and gas emission, to make very sharp turns—almost at right angles, and to consider the speed and variation of the wind, the sun and other weather conditions. Since the letters are all in one plane he can only see the side of the last letter he has written, which adds to his difficulties in keeping alignment. Apparently, however, all these difficulties of piloting technique have been completely overcome.

The invention has a number of scientific possibilities. It may add to our knowledge of atmospheric conditions as regards winds at varying altitudes. Experiments have been conducted under the auspices of the British Air Ministry in which the gas was led to various points on the airplane and since the gas followed the path of the air at such points, it was possible to make interesting records of airflow around an airplane. This may ultimately have considerable importance in the study of aerodynamics.

The Transport of Organic Substances in Plants

IN a recent address before the botanists of the British Association for the Advancement of Science Professor H. H. Dixon dealt with the transport of organic substances in plants. Organic substances are conveyed upwards in the rising transpiration and root-pressure currents. The transport is probably mainly effected in the tracheae of the outer layers of the wood. Ringing may block these channels completely or partially by the introduction of air-bubbles and by exudations from injured cells into the lumina and walls of the tracheae.

The downward transport of these substances from the leaves of the lower parts of the plant is usually assigned to the bast, although there is weighty experimental evidence that living conduits are not essential. Calculation shows that if the bast were used as the conduit a velocity of flow in it of about 50 cm. per hour would be required. In such narrow tubes as the bast is composed of, with frequent cross partitions and colloid contents, this velocity seems quite impossible. These considerations render it highly probable that the tracheae of the wood are the part for downward transport also. There is ample experimental evidence for downward as well as upward movement of sap in the tracheae. Tension in the sap determines a flow from any source above or below. Resistance to transverse flow in the wood practically subdivides that tissue into a number of longitudinal filaments of tracheae connected anatomically at various levels in the plant. Transpiration from the upper end of one filament may thus lead to a downward motion in a neighboring one. There is also conclusive evidence for this reversed motion in intact normal plants.

Recent work has shown that the transfer of stimuli from the receptive to the motile regions of plants is effected by the passage of hormones. In several cases it is certain that hormones are conveyed in the transpiration current. Moreover, the movement is often basipetal. Such a downward flow is clearly available for the conveyance of organic foodstuffs as well as hormones. Local increases in the permeability of leaf-cells will allow solutions of organic substances to pass into the tracheae. The tension generated in the sap by the transpiration of other leaf cells will draw this solution downwards in the tracheae. Experimental evidence for this method of transport is available. The volume-changes of leaves and parts of leaves observed during transpiration are in all probability the result of these changes in permeability, and are directly connected with the supply of organic substance from the leaf-cells to the transpiration-current for downward transport.

The World's Supply of Iodine in Relation to the Prevention of Goitre

IN *Science* for September 8, 1922, Professor J. F. McClendon of the University of Missouri discusses the world's supply of iodine in relation to the prevention of goitre. Dr. McClendon says practically all of the iodine of the earth's surface is in the sea, which contains about sixty billion metric tons of iodine in the form of inorganic salts. This iodine probably entered the sea at the same time chlorine accumulated in it. Iodides were probably the most soluble salts on the earth's surface, chlorides being next in solubility. If the earth was once hot on the surface, it is probable that hydriodic acid existed in the atmosphere and was washed into the sea with the first rain. Insoluble iodides of heavy metals are considered by Emmons to be secondary formations, due to the seepage of sea water through ores.

Judging by the prevalence of goitre, there is often a deficiency of iodine in our food and drink. At present, so little is known about the exact quantities of iodine taken into our stomachs that we can judge only by the number of cases of goitre. Omitting the details of local distribution of goitre, there is a wide goitre belt extending north along the Appalachian mountains to Vermont, thence west through the Great Lakes region to Montana and Washington and turning south it finally includes all of the Rocky Mountain and Pacific states. In fact, the goitrous belt includes the mountainous and glaciated regions. Since the run-off from mountainous and glaciated regions has carried away so much of the soluble material, it seems likely for this reason in addition to other evidence that the goitre belt is a low iodide belt.

Since the goitre belt includes large cities and millions of population, it seems unlikely at present that all of its inhabitants will receive iodide medication in pure form. Since the sea contains the bulk of the supply, the transfer of iodine from the sea to our food or drink should be increased.

Perhaps the simplest and most attractive method is the inclusion of seafoods in our diet, but this is limited. Since sea water and salt deposits contain iodine, salt might be made an important source of iodine in our dietary scheme. Salt could easily be prepared from sea water as described above with the retention of the iodine compounds and at a cost not exceeding that of present day table salt.

Hudson River Bri at

A Solution of the Moto ffic Upper H n H

CONSTRUCTION will be commenced this spring upon the handsome highway suspension bridge which is shown in the accompanying illustration. It will span the Hudson River at a point a few miles above Peekskill, N. Y., and opposite the popular Bear Mountain resort in the Palisades Interstate Park. The bridge is being built to form a greatly needed highway connection between the east and west banks of the Hudson, thereby giving a direct connection between the state highway systems on both sides of the river, and greatly facilitating not only the east and west roadway traffic, but that which flows in a north and south direction parallel with the river. A powerful predisposing motive for locating the bridge on the present site was the existence on the west side of the river of the Bear Mountain resort, which is visited by large numbers of automobiles on every day of the year on which motor car travel is possible, and on Sundays and holidays is the Mecca of those workaday people whose excursions far afield are limited to the weekends.

In a letter written to Terry and Tench, the builders of the bridge, by Major W. A. Welch, general manager of the Palisades Interstate Park, he states that during the season of 1921, on several Sundays and holidays, as many as 5500 motor cars stopped at Bear Mountain, and that the total number of cars during the season amounted to over 300,000. Furthermore, the motor car traffic had increased annually during the past five or six years at the rate of about 40 per cent per year. He goes on to say that had there been a bridge across the river, motor car travel from New York during 1921, in his opinion, would have increased 50 per cent over the 1920 traffic.

Hitherto cross-river traffic over the Hudson River south of Albany has been by ferry. The ferries were operated with reasonable satisfaction until the development of good roads and the widespread and ever-growing use of motor cars and motor trucks. During the last ten years the ferry service has been greatly increased in the endeavor to meet the emergency and several new lines are proposed at the present time. Also, certain of the existing lines are considering the building of additional boats.

But while credit must be given to the ferry companies for their endeavor to provide additional facilities, they are swamped by the ever-rising tide of traffic, and are unable satisfactorily to handle the business offered on Saturdays, Sundays and holidays. During the spring, summer and autumn season, when the automobiles are out in force, they have been unable to give adequate service, even on weekdays.

It is a matter of common experience for motorists to wait an hour or more for a ferry; many cars are subject to a wait of three or four hours at various times of congestion; and on Decoration Day, 1921, some cars had to wait as long as ten hours before they could cross the Dyckman Street Ferry.

It is, therefore, not so much the failure of the ferry owners to try to meet the situation as it is the development of good roads and automobile transportation during the last decade, that has given rise to the present necessity for a bridge crossing of the Hudson River within easy reach of the Metropolitan district.

At the time when the pontoon bridge over the Hudson River at Yonkers, N. Y. (illustrated in the SCIENTIFIC AMERICAN of Aug. 13, 1921), was under discussion, the question was asked if some suitable point for building a highway bridge across the Hudson could not be found, that would give relief in the present congestion until the great suspension bridge at Fifty-seventh Street, New York, is completed.

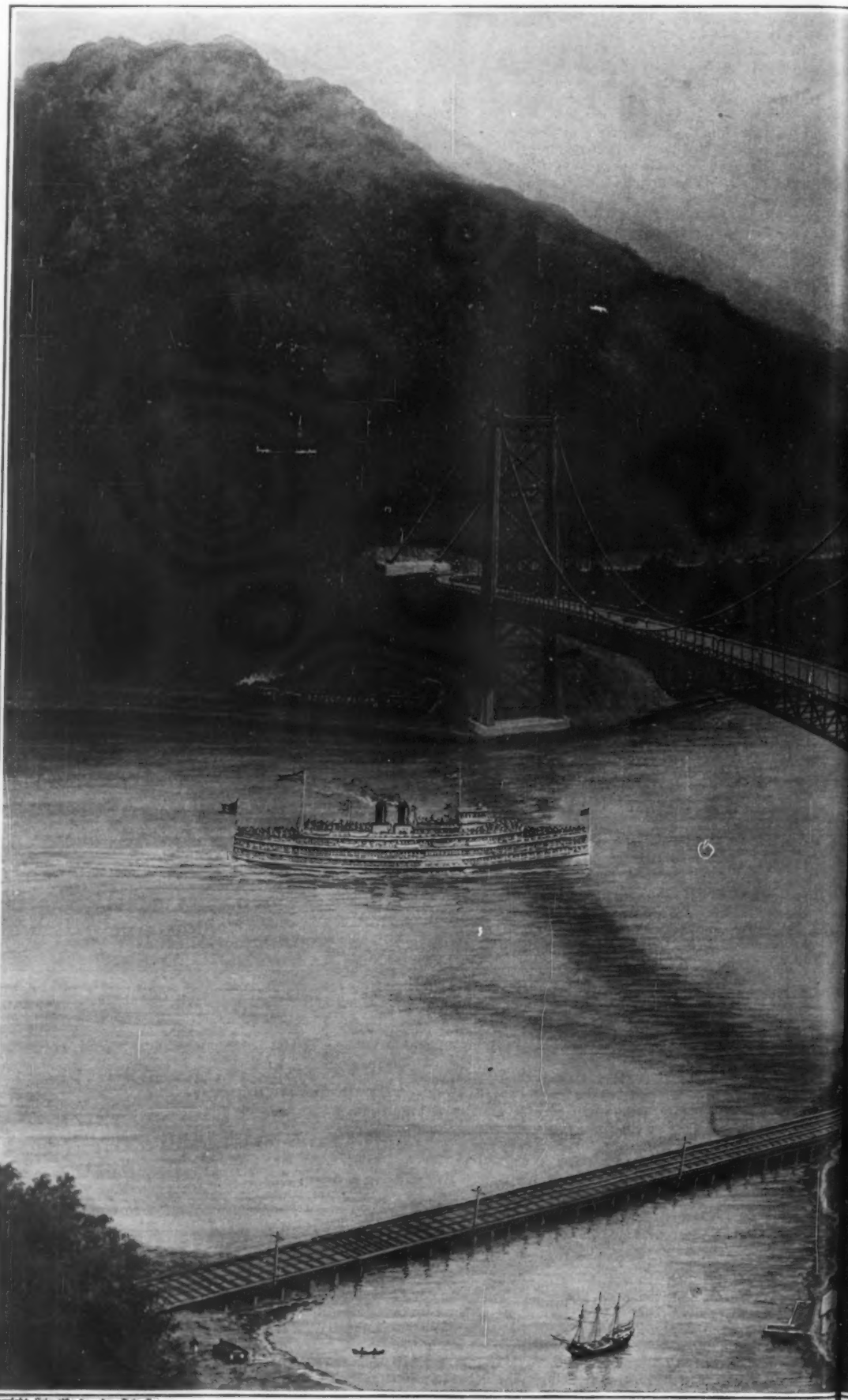
After an exhaustive examination of all possible bridge sites between New York and Poughkeepsie, a site a few miles north of Peekskill was selected as having the following advantages:

First, it was found that a highway suspension bridge for motor traffic including approaches on both sides of the river could be built for five million dollars, in less than two years' time.

Secondly, the bridge will be about 40 miles from the heart of New York City, and will make a direct connection between the main highway leading through Middletown to Binghamton, Syracuse, Elmira, Rochester and Buffalo, and the Albany Post Road on the east side of the Hudson River.

It will give residents of Tuxedo, West Point, Newburgh, and Kingston sections direct highway connection with New York City, thereby avoiding ferry delays at New York; and now that the Kingston bridge and Storm King Road are completed, it will give an all-land route from Albany to New York via Kingston, Newburgh, and West Point. Another great advantage, especially in the vacation season, is that it will give an all-land route to West Point, Palisades Interstate Park and the Catskill district, for residents of New York City and Westchester County.

Over and above the benefits to automobile travel will be the advantage of this crossing in quickening and cheapening the motor truck service. There is at present a very large freight-trucking business carried on from the farms, truck gardens, and dairies, of Orange County into New York City. At present this traffic goes through New York State to the west of the Hudson, through Suffern, and down to New York City through the northern part of New Jersey, finally crossing the Hudson by ferry from Jersey City to Manhattan. The necessity of taking all of this



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The Hudson River Bridge at Bear Mountain, which will connect the highway syste side of t system. Length of main span 1632 feet; total width of roadway 38 fe of tower

Bri at Bear Mountain

Motoffic Problem Across the pper Hn River

freight over the congested roads in northern New Jersey and the ferries, is felt to be a big handicap; and it is expected that most of it will reach the city via Central Valley, Highland Falls, and the new bridge and down the roads on the east side of the river. There has also recently been developed an extensive freight business by motor truck from the New England States to distant cities lying to the south and west. At present these trucks use the Lincoln Highway through New Jersey, and have to pass through the congested Metropolitan district and use the same ferries across the river.

We give the above rather extended statement of the traffic conditions as an answer to the question that has been asked, as to why such an important bridge, one of the longest suspension bridges in the world, should be erected at a point so comparatively remote from the big city centers. Considered strategetically, as a glance at any road map will show, the site has been wisely chosen.

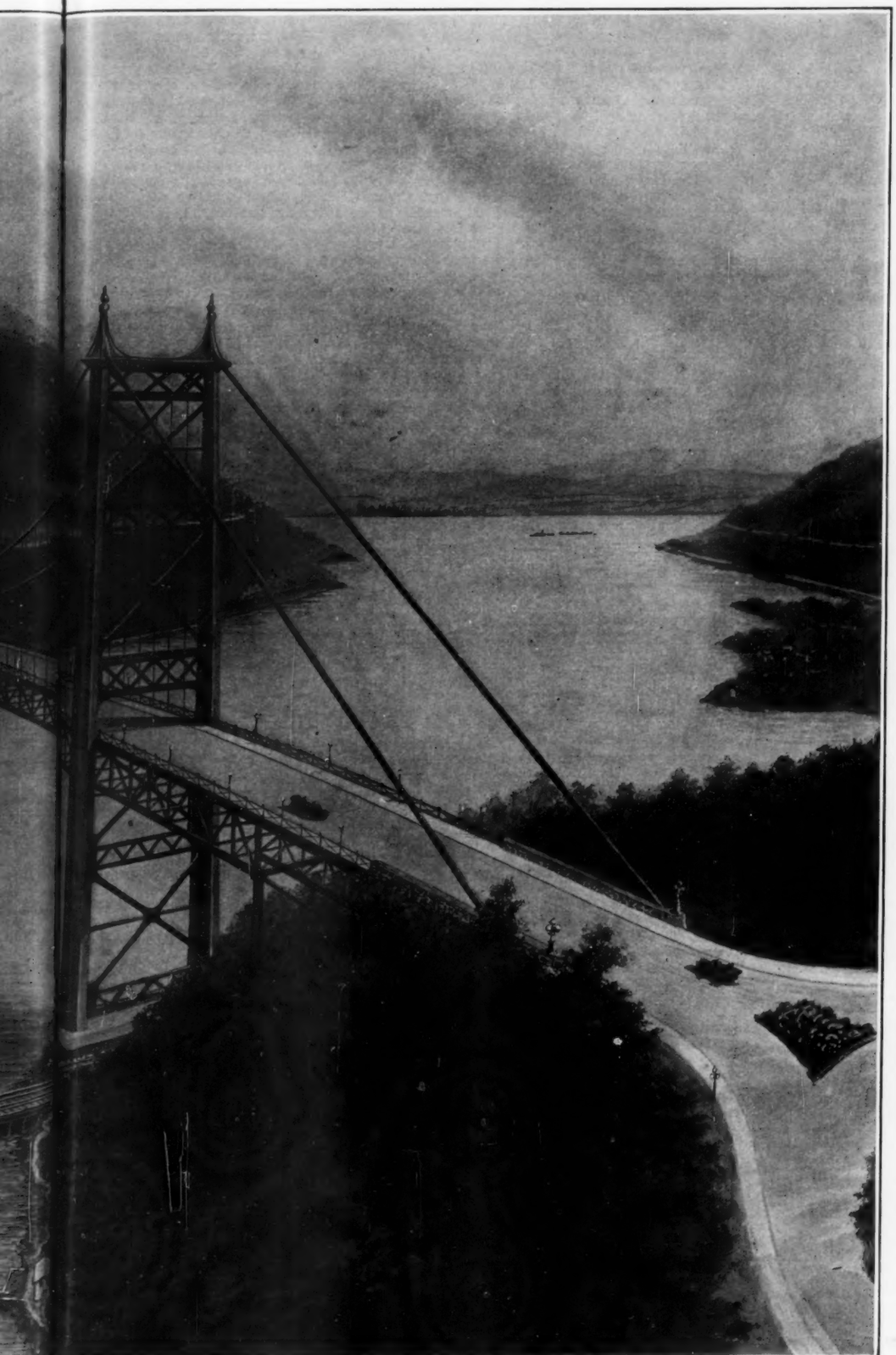
The new bridge will consist of a main span 1632 feet in length between the center of the main towers, and two shore spans, each 210 feet in length. The floor of the bridge will be carried on two 17-inch wire cables attached to solid anchorages at each end, and carried upon two towers each 350 feet in height, measured from the top of the concrete piers, The underside of the bridge will have a clear height of 153 feet above the river. The traffic will all be accommodated on a single floor which will consist of a central roadway 30 feet in clear width between the curbs and two sidewalks each four feet in width. The floor will be hung from the cables by 2½-inch wire ropes. At their lower ends the suspenders will be attached to transverse floor-beam trusses, the distance between the trusses being spanned by longitudinal plate-steel stringers. Upon this system will be laid a roadway consisting of a concrete base with an asphalt-block surface.

To stiffen the floor under the moving traffic two stiffening trusses 30 feet in depth are provided, one on each side of the floor. These trusses will be spaced 55 feet apart, center to center. The triangulation of the trusses will be the same as that of the Manhattan Bridge across the East River, with non-intersecting members and verticals at each angle.

Each tower will consist of two built-up posts tied together with stiffening trussing. Each post is 30 feet in width at the base, measured parallel with the axis of the bridge, and tapers to a width of 11 feet at the top. Transversely, each post has a width, throughout its full height, of 6½ feet. Although the posts have a rather light appearance for a bridge of this magnitude, in reality each is a very stiff member, consisting of two closed double-box outer sections, tied together on their inner faces with a heavy plate diaphragm and with two lines of latticing.

The particular site chosen for the bridge is favored by the fact that a good quality of solid rock exists for the pier and abutment foundations. These, as well as the end anchorages, will be built of high-grade concrete. Our view of the bridge is taken from the west bank of the Hudson, and we are supposed to be standing on the Henry Hudson Highway, which is in great part completed and will extend from the Dyckman Street ferry opposite the north end of Manhattan Island, along the west bank of the Hudson to Newburgh. Throughout its whole length it will be built on the west bank of the river and run through Palisades Park. At the right of the picture, looking down the Hudson, we see, first, Iona Island where there is a government arsenal, and beyond that the great highway is seen swinging around what is known as Jones's Point. On the opposite or easterly bank the roadway leading from the bridge swings to the right and follows a new road three miles in length, which extends around the mountain to Roa Hook, where it connects with a road which leads to the Albany Post Road. It is claimed by its sponsors that this new road will be fully equal to the recently completed Storm King Road, both in the difficulty of its construction and in the beauty of the vistas which it will afford both up and down the Hudson River.

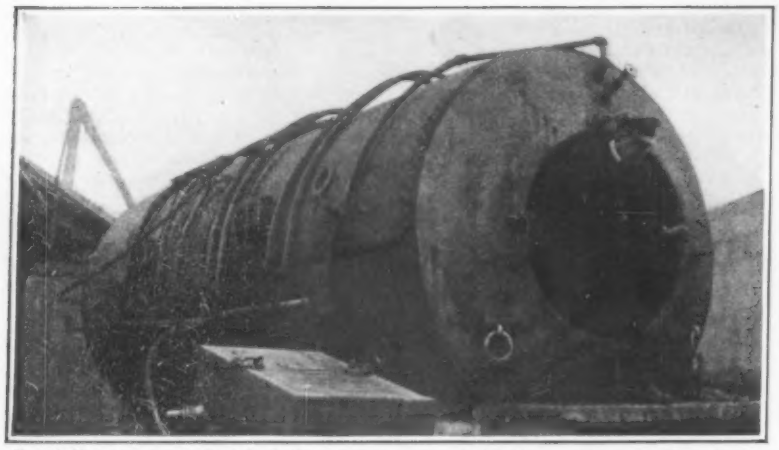
The railroad tracks running upon the trestle bridge in the foreground are those of the West Shore Railroad. Toward the left end of the bridge will be noticed a narrow drawspan, through which the full-sized model of the Half Moon was towed to its resting place, as shown at the bottom of the picture. The tunnels and tracks on the opposite side of the river are, of course, those of the New York Central main line. The bridge was designed by Mr. Howard Baird of this city.



system side of the river and eliminate the long detours and delay of the present ferry
38 fe of towers 350 feet. Clear height of floor above river, 153 feet

Improved Highways a National Necessity

HIGHWAY transport is not a single responsibility. Its efficiency depends not solely upon the highway engineer nor the automotive engineer, but upon their hearty cooperation. It is just as harmful to limit the axle weight of trucks by laws based upon the present condition of roads, except of course as a temporary measure, as to expect that highway departments will respond to every caprice of automobile design. Highways must, however, be considered as only a means to an end and that end, national transport. It is just as necessary to pass regulations governing the nature and the strength of roads as to pass regulations controlling the weight and speed of the vehicles using them. The future highway must be constructed with regard to its use by self-propelled vehicles, and the automotive engineer, because of the heterogeneous types of road surfacing, must design and construct reasonably light vehicles capable of carrying its load at minimum cost.



Specially constructed airlock for the purpose of effecting a cure of the caisson "bends" by very gradually releasing the air pressure

A High-Pressure Tank to Cure the Ill Effects of Pressure

WHEN a man subjects himself to a greatly increased air pressure a large amount of air gradually finds its way into every part of his body, and even into his blood until the pressure of the atmosphere inside balances that outside of his system. This, however, is not the cause of the bends, which comes, instead, when the process is reversed and the man finds himself carrying a higher pressure inside than outside of his body. If the transition from the high pressure of a caisson to the pressure of the outside atmosphere is made too rapidly the man is apt to become the victim of the ailment known as the "bends." Literally, he bends—doubles his body up into a knot and suffers agonies of pain.

The cure for this attack is simply to put the victim back under air pressure and to lower this pressure more gradually than before. To effect this purpose a tank has been constructed for the use of physicians stationed at the vehicular tunnel now being constructed under the Hudson River at New York. The pressure in this tank is under perfect control and the sufferer can thus be aided to overcome the ailment, at the same time that he is encouraged to go through physical exercises to hasten the release of the excess of air from his body. This pressure tank, with its separate air locks, is quite portable for use anywhere.

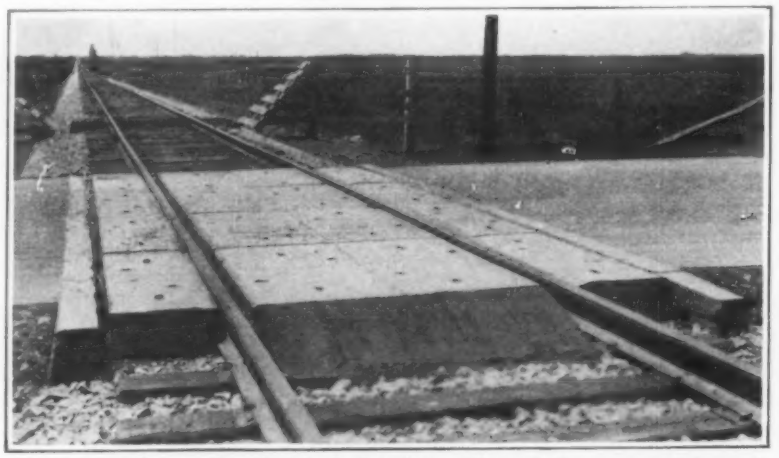
A Novel Surgical Tool

ANY attempt at medicine or surgery necessarily involves access to the patient's interior. The doctor and the surgeon have always followed diametrically opposed methods of gaining this access. The doctor does not go inside the patient at all; he sends a messenger, in the form of pill or powder or liquid, which (presumably) sets up a chemical reaction of a corrective nature that, if all goes well, remedies the difficulty from which the patient has been suffering. The surgeon, however, employs actual tools in preference to chemical reagents. He has for many years been in the habit of entering the patient's body at the point nearest the affected region, cutting his way right through the intervening tissue much as the plumber upsets the work of the carpenter when the water pipes spring a leak. Only the surgeon closes the hole behind him as he withdraws from his patient's interior, while the plumber scorns to do this.

Of late, however, the surgeon has been turning more and more toward a different technique. We may preserve our mechanical analogy if we compare his work, not with that of the plumber, but rather with that of the electrician called in to wire or rewire an old house. The electrician does not rip out the walls for this purpose; he has tools that enable him to stay outside the wall interstices and at the same time to work very nicely within these spaces. In the same way, the surgeon is today building up a technique which enables him to stay outside the patient, and still to work inside him, in a true surgical and not merely in a medical sense.

The lowering of lamps and other apparatus into the patient's interior through the mouth is one phase of this work. There really isn't much in the way of ailments of esophagus and stomach that can't at least be examined in this way, if not actually treated. And now we have a brand new tool for the surgeon, invented by O. B. Schellberg, a New York therapist who specializes in diseases of the intestinal tract. Schellberg has found it possible to construct a rubber tube sufficiently stiff so that it will not double on itself or be blocked by intestinal pressure, yet sufficiently flexible so that it can be pushed, from below, clear through the large intestine, from end to end. It is found of extraordinary utility in clearing out toxic conditions of the large intestine, and even in breaking loose severe intestinal adhesions. The use of this tube is made possible in skilled hands, by the addition of a three-way valve and special tanks, also devised by Schellberg, the complete apparatus giving perfect control of inflow and outflow of the fluids employed.

The inventor has given, in five years, no less than 36,000 treatments with this instrument, and has gained the recognition of physicians for his apparatus. It makes irrigation a simpler and more effective process than before, and provides a means of introducing medicaments which cannot be introduced through the mouth, or of actually planting colonies of beneficent bacteria in the intestine. Altogether, it seems to mark a distinct step in the application of invention to surgery.



Concrete grade crossing that is designed to withstand the wear and tear of traffic without injury

Mammoth Ground Plate for Power Plant

IT is sometimes very difficult to obtain a perfect connection with the earth, especially in certain places where the soil is dry. As the area of the ground plate is increased, however, the chance of some part of it always being in contact with wet earth is increased, especially when the plate traverses several strata of soil.

In an effort to get such a perfect earth connection at the Pit River power plant in California a large steel plate measuring 20 x 8 feet was buried in the earth at the side of the tailrace and to it were welded six cables which led to the transformers.

Mammoth steel ground-plate for California power plant, about to be placed in the pit dug for the purpose

The Harvard Study of Mental and Physical Development

IN order to find out exactly how the individual child grows in mind and body, the Harvard Graduate School of Education, with the cooperation of public and private schools in the vicinity, has embarked upon an investigation of the mental and physical development of hundreds of schoolboys and schoolgirls. This investigation is expected to occupy twelve years, and is regarded as the first of its kind ever undertaken on so large a scale.

The plan of the investigation is to take several hundred children and submit them at intervals to measurements and tests over a period of twelve years, say from the age of six to the age of eighteen. This will give an accurate record of how each individual child is growing mentally and physically throughout that period. Hitherto practically all the information secured by physicians, teachers and psychologists on the mental and physical growth of children has been based on averages from the measurement of groups, and thus has thrown but little light on the relation between bodily and mental growth in the individual.

Hundreds of children are now being examined by Professor Dearborn and his staff at the psycho-educational clinic at Harvard, which has been specializing for several years in the measurement of intelligence and the testing of school accomplishment. Each child is given intelligence tests (group and individual); has his school accomplishment measured by means of standardized tests in reading and arithmetic; and has his teacher's judgments and observations of the above recorded. His height, weight and bodily proportions are also measured; his physical condition is observed; his teeth are examined to see how the process of dentition is coming along; and the ossification of the carpal bones is shown by the X-ray photographs.

By repeating these measurements at intervals for twelve years, the Harvard investigators hope to secure complete records of the individual development of a representative group of children throughout their school course.

A New Concrete Slab Grade Crossing That Decreases Maintenance Cost

ONE of the chief difficulties in road maintenance is the highway or grade crossing. In Texas a city engineer experienced a great deal of difficulty in getting any kind of a crossing which would not require an abnormal amount of maintenance. Finally, as a result, he set about the development of a concrete slab crossing, which is shown in the accompanying illustration. The railroads in Potter County, of which Amarillo is the county seat, were requested to use the crossing shown.

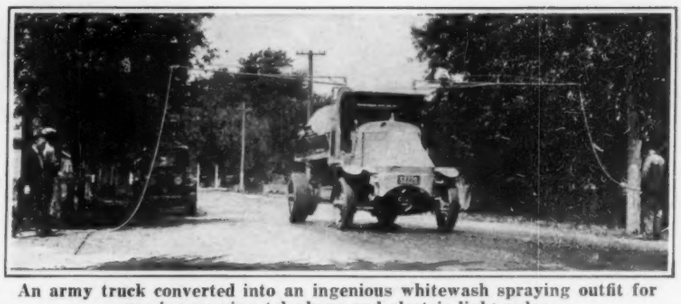
The design has concrete headers on each side of the ties, round holes in slabs for screw spikes, oblong holes for a hook bar to raise the slab and angle iron on the edge of the slabs. These are beveled on the sides next the base of rails and also on the center slabs on the bottom. One-inch rods are used for spacers to keep them away from the rails.

The most difficult crossings are those where a street car line intersects a railroad, but the new concrete slab crossing after six months' use was entirely smooth and had had no repairs. With the concrete slab crossing the slab can be removed for ballasting with no disturbance of the road and put back at the same level by unskilled workmen at a minimum of cost.

From Battlefield to Road Jobs

What the States Have Done with the Surplus War Supplies Turned Over to Them

By D. H. George



An army truck converted into an ingenious whitewash spraying outfit for use in spraying telephone and electric light poles

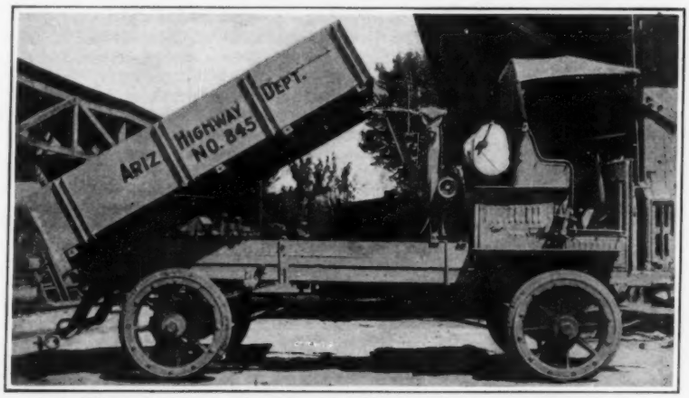
OF THE many extraordinary equipments used ingeniously by State and Federal road builders, without question the most peculiar are the elephant and trench shelters—designed and built for protecting our soldiers from the shells of the enemy during the recent war—which have been converted into the most novel culverts in all creation by the Arizona State Highway Commission.

Uncle Sam has distributed more than $150,000,000 worth of surplus war materials to the different States for use in the construction and maintenance of highways. This great mass of material contained practically everything in the line of tools and mechanical appliances, from cranes, derricks and steam shovels, down to picks, axes, shovels and other hand tools. Among these Government gifts were 30,000 motor trucks and automobiles as well as $12,000,000 worth of accessories.

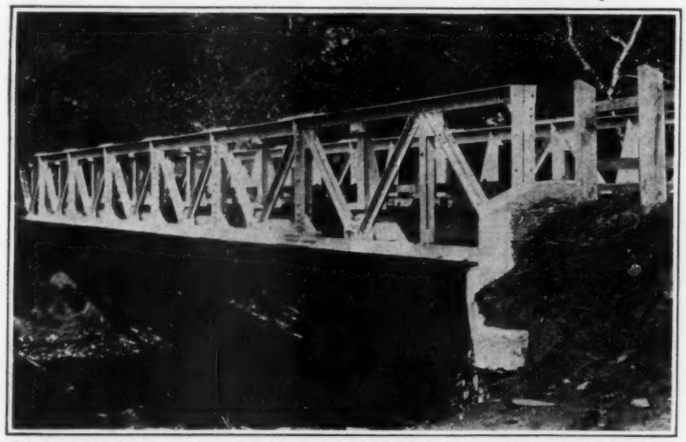
Most of the States used the heavy, semi-cylindrical, bombproof, trench shelters for the storage of T. N. T. and other explosives employed in road building operations. In Arizona it does not rain very often, but when Jupiter Pluvius occasionally gets busy, he tries mighty hard to wash the entire State down into the Rio Grande. Veritable cloud-bursts occur and turbulent floods go seething down the shallow drainage channels, completely wiping out the roads unless they are adequately protected by large-sized culverts. When the Arizona engineers first saw the trench shelters presented to the State by Uncle Sam, they immediately conceived the idea of transforming the shell shelters into culverts. They have scattered the homespun culverts about the flood areas, placing them upon concrete or redwood foundations. They anticipate that these painted, homemade and inexpensive culverts will last for a long time in their arid regions of limited precipitation.

New Jersey has made almost as unique use of large army motor trucks which were originally designed as water sprinklers, being equipped with special centrifugal pumps which were driven by the propeller shafts. These huge, automatic watering carts have been made over into whitewashing outfits which are now kept busy spraying whitewash over the telephone, telegraph and electric light poles along the State highways. The New Jersey State engineer who was the originator of this novel scheme, explains how he converted the trucks into spraying machines in this manner: "The sprinkler heads at the rear were disconnected and two other connections were made from the outlet of the pump—one extending forward and the other to the rear. The forward connection was carried to pipes at each side which rise to the top of the cab and are there connected to the garage car-

An important Arizona bridge on which the hand rail is made of surplus war pipe, previously used to carry compressed air to jack hammers



A rehabilitated army truck equipped with dump body and automatic hoist



One of the army sectional bridges which has been used advantageously in bridging a river in the Pisgah National Forest

washing swivels. The other connection enters the tank through the filling cap in the bottom. An L was placed on this connection inside the tank with a short nipple pointing forward. It operates to agitate the whitewash. The spraying mixture is pumped through the forward connection. The garage swivels have been lengthened to 10 feet and are provided with 25 feet of hose which permits the traffic to pass as the truck is at work."

The 22,000 motor trucks distributed among the 48 States have markedly aided road building activities in all parts of the country. Most of these trucks have been equipped with automatic dump bodies and hoisting devices. Idaho engineers have changed the original steel ammunition bodies of the government trucks into hopper bodies by installing false bottoms sloping from front and back to a system of drop doors for bottom dumping which are controlled mechanically and efficiently from the driver's seat. Maine highway experts have revised their trucks by removing the cargo body from the chassis and by pivoting it near the rear end, as well as adding a hoisting device, thus transforming the regulation army body of the truck into a satisfactory and durable dump body. Maine and Vermont engineers have also remodeled their trucks so that the loads can be dumped from the sides of the machines. This was accomplished by changing the sides so that they could be dropped or raised as desired.

Reports from Arizona are to the effect that the steel, ordnance bodies were too high and not wide enough for road building operations. Construction experts in that State cut the truck bottoms in half from front to back and then used the sides for new bottoms and the two halves of the bottom for new sides, thus changing the body so that it was twice as wide and half as high as it was initially. This reform makes it easier to shovel into the truck from the ground, while it also facilitates the transportation of more bulky freight and material. These re-made trucks have also been provided with hand hoists and offset bars on the rear ends in order that they may haul road blades and drags.

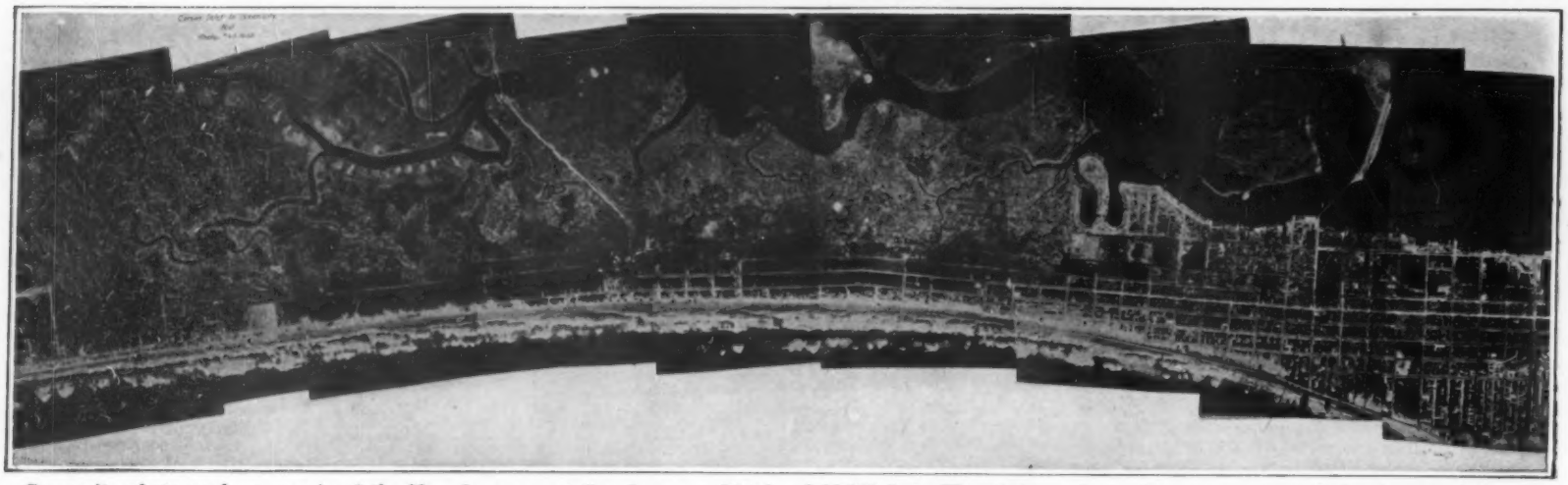
Some of the army ambulances which were apportioned among the States engaged in highway construction on extensive scales, have been converted into portable headquarters and offices used by special survey parties. In other instances, they have been remodeled into buses for hauling convicts to and from their work on the public roads. Nearly all the States in the snow belt use most of their rehabilitated army trucks to push snow plows and clear the roads for traffic during the season when Jack Frost reigns supreme. During the summer, some of the trucks are revamped so that they serve effectively as sprinkler carts.

Arizona authorities have built a special central warehouse which serves as headquarters for their war-salvaged road-building materials. It is made out of corrugated iron supplied by Uncle Sam. A most novel set of awnings are used to shade the sun from the office windows. They consist of the extra tops for the truck driver's seats and are admirably adapted to the unusual service to which they have been put. Canvas airplane hangars have been used in a number of the western states as storage places for the various road-building materials.

Approximately 150 miles of pipes of all types and sizes have been utilized in a variety of ways. Much of this pipe has been put to work carrying water to concrete mixing machines. Nebraska has transformed much of its quota of two-inch pipe into heating coils which are used to warm the garages where the road trucks are housed. A large part of the two-inch and four-inch pipe has been used in making hand-rails for bridges and culverts. One lot of pipe of this description was first used to carry compressed air from the compressors to the jack hammers employed in excavating the bridge foundation, and, subsequently, it was used as hand rails.

Seventy-five carloads of sectional bridge material have already been used in constructing durable and inexpensive bridges in the national forests. These bridges come in sections about six feet deep and provide for an 11-foot roadway with the trusses 14 feet apart. They are strong enough to carry 15-ton truckloads of freight for spans up to 114 feet long. The

(Continued on page 360)



Composite photograph or mosaic of the New Jersey coast line from an altitude of 10,000 feet. The photographs in this case were made by Army aviators in co-operation with the U. S. Coast and Geodetic Survey

Mapping From the Skies

How Aerial Photography Is Being Employed to Chart Our Heretofore Inaccessible Coast Lines

By George H. Dacy

FOR THE first time in the history of our domestic navigation, the Mississippi delta has been studied and mapped. This marshy region has previously been inaccessible because of its quagmire bottoms and its heavy growth of wild cane ranging from 10 to 12 feet in height. So the present achievement marks a new epoch and era in the annals of our national Coast and Geodetic Survey. Careful bird's-eye studies of the swamp and marsh lands in the delta country south of New Orleans, which covers a tract of approximately 2500 square miles, have been made, and accurate photographs have been taken from airplanes operated at altitudes of from 8,000 to 10,000 feet. These pictures and observations, obtained as a consequence of the novel adaptation of Government airplanes for coast surveying work, are introductory of a new and novel feature of coast mapping and indicate that, potentially, no sections of our American coast lines will be so isolated from human habitation as to be impossible of ready and certain investigation and identification.

Our coast lines are constantly changing and shifting, which necessitates perpetual re-checking and correction of initial surveys. Hitherto, many of the marshlands—and there are hundreds of miles of such lowlands which have elevations of less than 10 feet above sea level—have never been surveyed because none but web-footed, aquatic beings, if there were such, who could stamp about in mud and marsh which would mire a dog, could ever penetrate any distance into these modern morasses. In the southern gulf borders where wild cane grows luxuriantly, foot survey parties were constantly blocked in their efforts to map the coast marshes because of the maze of cane which effectually handicapped such activities. These problems which, heretofore, have been insurmountable, have now been solved by the enlistment of airships for such work. Future plans of the U. S. Coast and Geodetic Survey feature the early exploration and exploitation from the sky of more than 2400 square miles of coast line which bounds North and South Carolina, Georgia and Florida. Ultimately the Government experts expect to make aerial photographs of the entire coast line of the United States.

Thus far the aerial mapping has been done cooperatively by the U. S. Coast and Geodetic Survey, the U. S. Navy and the Engineer's Corps of the regular army. Seaplanes of the modified torpedo-plane type, equipped with low-compression, 12-cylinder Liberty motors developing 385 horsepower, have been used. These planes are provided with twin pontoons and have demonstrated their efficiency as the airships best adapted for such work. The camera is so arranged in each plane that it is well above the water and is protected from spray by means of a sliding metal door set in the fuselage of the airship bottom. This door can be closed easily when the plane is taking off or about to land, or at whatever other time the photographer desires to guard the lens of his camera against injury. Attempts have been made to utilize the flying boat or single pontoon type of airplane for mapping purposes, but these experiments were abandoned on account of the difficulty of contriving a safe and satisfactory door for the camera lens in the bottom of such air craft.

The seaplanes used in aerial mapping have maximum speeds of approximately 90 miles an hour, although in the coast photographing operations, the machines are run at 55 miles an hour. It takes one of these planes about 55 minutes to climb to an altitude of 14,500 feet while they soar to a point 8,000 feet above the surface of the earth in approximately 22 minutes. It is at the latter elevation that most of the geodetic and coast survey photographs are made. All the planes used in this work have been remodeled to the extent that the observer or photographer sits in front of the pilot—just the opposite to the original arrangement—as this brings the extra weight of the camera nearer the center of gravity in the front cockpit. It also provides more satisfactory locations for the pilots, inasmuch as, they can watch the ground and landmark points better from the rear of the seaplane because the lower wing does not shut off any of the view at this angle.

Special film cameras designed expressly for aerial mapping activities are used. Each roll of film is 75 feet long and makes 90 pictures, each of which is 18 by 24 centimeters in size. The camera is automatic, being driven by an air motor attached to the outside of the airplane, which runs fast or slow in accordance with the velocity of the plane and the character of the wind. Each camera is of the universal focus variety with a 12-inch focus lens. The camera is adjusted so that it will take a picture automatically every 15 or 25 or 50 seconds as the aerial photographer desires. Ordinarily, when operating at an altitude of 8,000 feet, the camera is set to make a picture every 25 seconds, the average exposure being for a period of 1/190 of a second. With the plane running at a speed of 55 miles an hour at such an elevation, the camera makes a continuous photograph of a stretch of coast line 1¼ miles wide and as long as the survey party desires. These individual photographs are numbered as they are developed and ultimately are pasted together and assembled into a large composite or mosiac picture which is an accurate and miniature replica of the coast country covered as seen from the sky.

In the Mississippi Delta country the wild grass grows to a height of 12 feet and is so dense that survey parties on foot cannot map the territory

The cameras used originally in these investigations were set up in the airplanes so that they pointed directly downward when the airplanes were traveling on even keel. Now one of the greatest difficulties which the mapping pilot experiences is to hold his ship in this position during the photographic operations. Each camera is mounted in a cushioned framework so that it is protected from any vibrations of the plane. If the plane lists or tilts, the camera makes oblique negatives which introduce aerial errors into the work. Only the most skilful and painstakingly trained aviators are able to fly satisfactorily for mapping flights. The strain on the birdmen is most severe, and, ordinarily, five hours of aerial navigation of this description constitute a hard day's work. An existing scarcity of trained personnel, educated and experienced for coast surveying of this sort, is one of the greatest impediments in the way of carrying on the work, combined with inadequate appropriations and lack of funds—which limit the extension of such novel investigations.

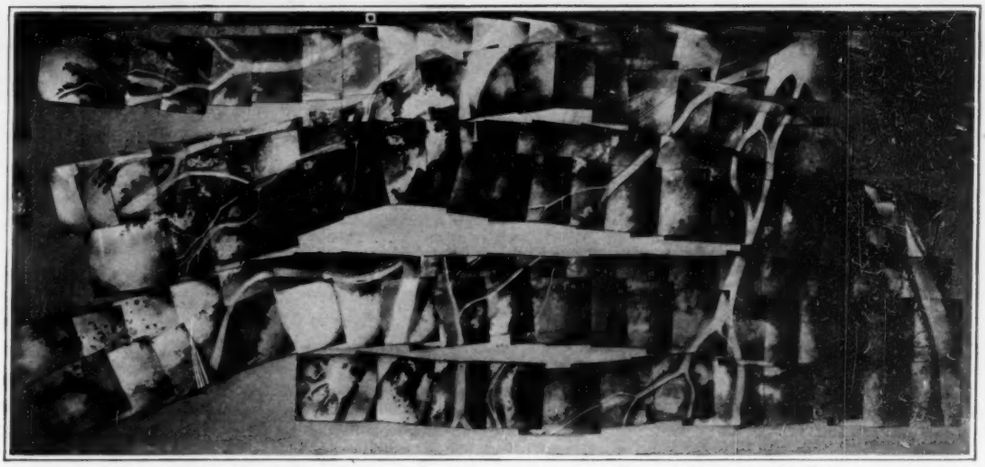
The ordinary, airplane level vials are the only available indicators which the mapping aviators can use to inform them during their flights concerning the stability of the camera. The recently improved cameras are so equipped that they can be rotated and shifted as the planes tilt or crab when exposed to a heavy cross wind. However, for the most part the leveling of the planes is largely dependent on the skill and experience of the helmsman. Usually the light is so bad that ascents for mapping purposes can not be made before about nine o'clock in the morning. At that time, if the atmospheric conditions are right and the sky is neither smoky from forest fires, hazy, cloudy or otherwise overcast, the mapping party takes off. The plane climbs quickly to the proper altitude. Then the pilot takes his proper bearings and jockeys the ship into the desired position so that the initial flight may be directly along the coast line to be surveyed.

Thereupon, the aviator starts on the first leg of the aerial trip, the photographer having adjusted the camera so that it begins to make exposures as soon as the

plane passes the desired station or landmark where picture-taking was terminated during the previous flight. The pilot steers the ship along the coast until the desired exposure of negative has been made. Then at this terminal, he heads the air boat straight inland a distance of 1¼ miles. This places the plane in exact position, after it has been reversed in direction, so that the party can fly back on a course parallel to the first flight in order that another stretch of marshland 1¼ miles wide can be photographed and so that the negatives will overlap. Anyone can immediately understand when he reads this that the slightest deviation of the airplane from the true course will show up in the completed negatives which will not dovetail and overlap properly. The backward and forward flights are continued until the lowland tract proximate to the coast which is to be mapped, has been covered.

Unstable air conditions over the Mississippi delta country now being surveyed often prevents flights on days which, otherwise, are ideal for aerial mapping work. These conditions obtain due to the unequal evaporation which occurs between the fresh and salt water, and are the first of their character that have been studied and analyzed since the inception of aerial navigation. The mapping parties have also made many interesting studies of cloud, haze and sunlight conditions as they facilitate or handicap aerial photography. They have become so expert in analyzing and diagnosing sky conditions from the ground that, as a rule, they can predict early each morning whether or not the weather conditions will permit of making coastline pictures from up above the clouds that particular day.

The amount of photographic work performed during the average flying day of five hours depends largely on air and wind conditions. During four flights which covered a total of nine hours flying, 593 photographs were made at an elevation of 5,000 feet which covered a belt of coast country 57 miles square. On another occasion, two flights made during the same day were productive of 261 satisfactory pictures, and on still another morning 155 excellent pictures were made during a sky trip which required 2½ hours. At altitudes of from 8,000 to 10,000 feet, three times as large an area can be covered and photographed in the same time as at elevations of 5,000 feet, this being explanatory of why most of the pictures are taken at the higher levels above the earth. The average cost of making surveys of the coast country by airplane are only about one third of the expenses which accumulate where Uncle Sam sends out organized expeditions on foot to do such work. For successful results, the airplane mapping has to be confined to marshland sections and tracts of country of very low elevation as contour and topographical photography from airplanes in regions of high and varying elevations has not as yet been perfected, at least in this country.



A mosaic of some of the Mississippi Delta. The pictures do not overlap as they should. They were made in an unusually stiff wind, and it was impossible for the aviator to hold the plane in the correct course

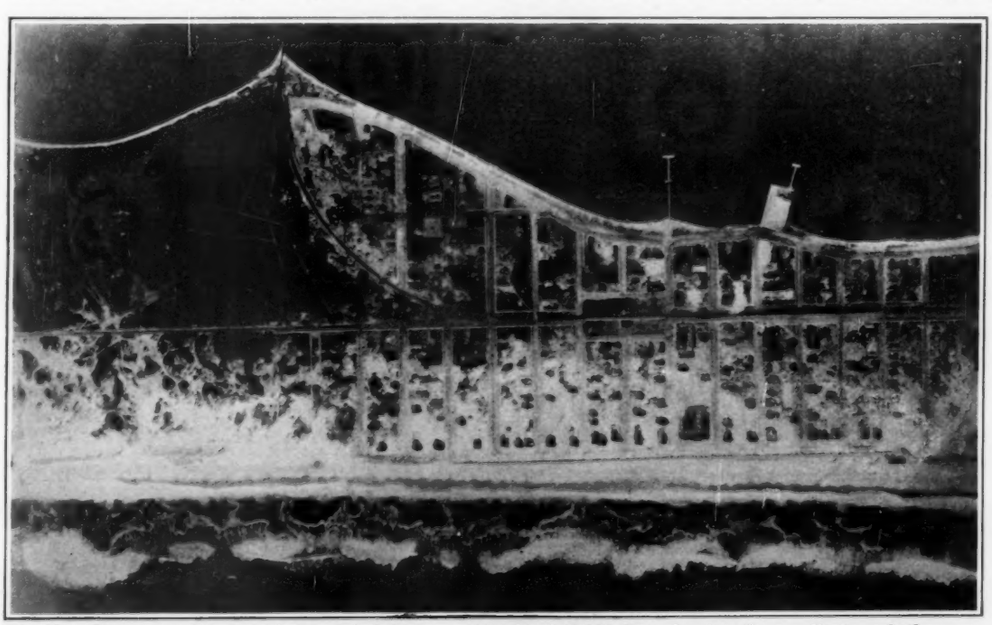
The camera is set up in the front cockpit of the seaplane with the lens pointing directly downward. It is operated by a wind motor and pictures are taken at intervals of 25 seconds

In addition, the U. S. Navy in cooperation with U. S. Coast and Geodetic Survey has consummated some interesting investigations in photographing submerged rocks and snags near Key West, Florida, from seaplanes. The purpose of these experiments was to ascertain if it was practical to locate and photograph from the air small coral heads and pinnacle rocks in the clear waters of the Florida coast which were menaces to navigation, rather than to seek out these snags by the more costly and customary system of dragging with huge wire nets. The photographs were taken from altitudes which ranged from 200 to 4,000 feet above the surface of the water. Two Government ships were used as control marks or guide posts in these unusual photographic experiments. The two vessels would steam at full speed ahead while the seaplanes flew back and forth overhead taking the pictures of the water and dangerous rocks under the surface. The courses and positions of the vessels were recorded as in ordinary sounding surveys.

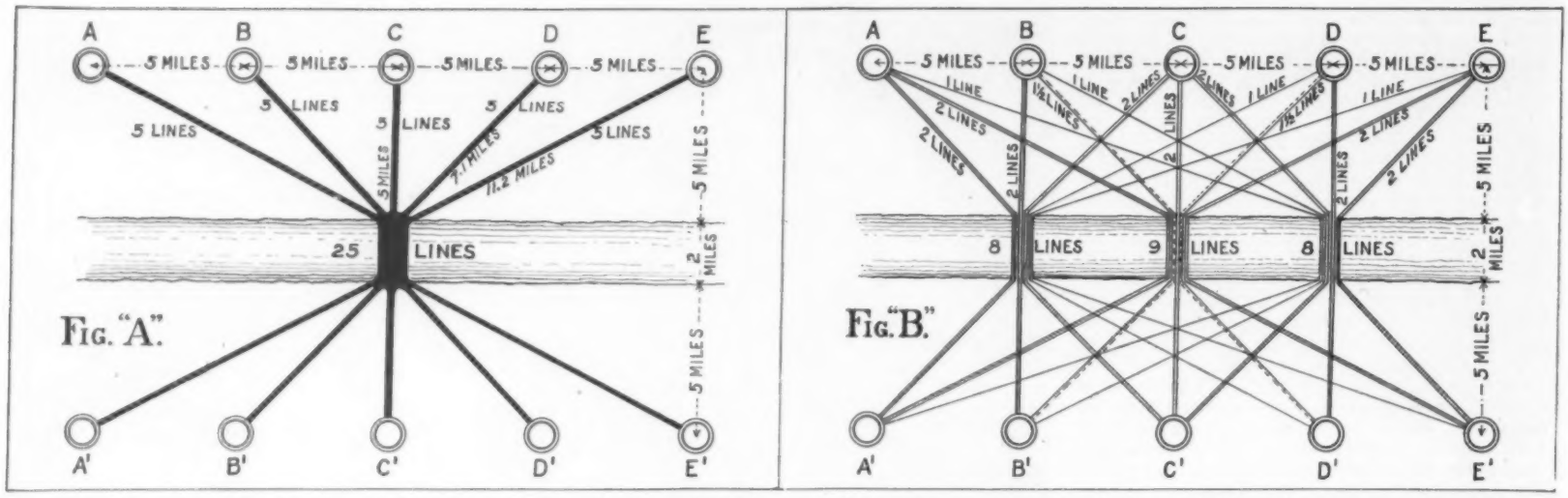
The photographers in the seaplanes kept tab on the exact time when each exposure of the camera was made as well as other data concerning the altitude, length of exposure and kind of plate used. Thereafter, each picture was identified and oriented by plotting the exact positions of the vessels on a large chart at the moment when the picture was made. These studies proved conclusively that photographs taken from the sky using present-day equipment are of little practical value to the hydrographer. Contrasts of color in the pictures complicated matters as there was no positive method of telling whether the contrasted colors indicated shallow or deep water. Various colored bottoms of uniform depth appeared in the pictures as apparent differences in depth. Many charted shoals did not show at all in the photographs while others were clearly visible.

The survey of the Mississippi delta was begun last March. Atmospheric conditions are such in that vicinity that mapping flights can be made only during May and October, as hazy days are frequent and forest fires often break out to complicate aerial photography. During the period from March 22 to May 6, of the year 1922, only 16 days out of 47 were suitable for sky mapping activities, and of these, five fell on Sunday, while during three of the other bright days, the airplanes were out of order. Hence there were only 8 days during that period when aerial mapping could be done. During October, when work was resumed, several airplane mishaps tied up the work. On one occasion, a pilot was blown out to sea 150 miles where his damaged plane drifted about for more than 52 hours before he was rescued.

In the marshy and swampy sections, landmarks are as scarce as drinking water, so that it is extremely difficult for the aviators to hold a straight and true course. Up to this time no very satisfactory aerial compasses have been invented. The present types are entirely too responsive to excessive airplane variations. Therefore, dependence must be put on guidance by landmarks, however poorly defined these may be, and before the average pilot is fitted for marsh survey work he has to undergo special training in their interpretation.



The New Jersey coast line as photographed from an altitude of 10,000 feet, showing the excellent work than can be done in this manner



These diagrams prove there is only a slight saving in average haul by substituting several tunnels for a single large bridge. Left-hand diagram shows five points on each side of a river between which traffic moves over a bridge accommodating 25 lines. The right-hand diagram shows the same 25 lines accommodated in three tunnels. The average haul by bridge is 18.6 miles and by tunnels 17.0 miles. It would take six tunnels to equal one bridge, and the cost would be doubled.

Convenience of Bridge and Tunnels Compared

IN connection with the problem of bridging the Hudson River at New York, statements have been made to the effect that a series of crossings, by tunnels or bridges of moderate capacity distributed along the river, is preferable to a single bridge of large capacity. It is argued that such a bridge is less convenient to the traffic, and that the concentration of a large amount of traffic causes congestion not only at the entrances of the bridge but in the adjoining streets.

To illustrate the fallacy of these statements we present herewith two diagrams which represent the two different systems; the one with a single crossing being represented in Fig. A, and the one with several crossings in Fig. B.

In the illustration it is assumed that the traffic originates and terminates, on both sides of the river, at five separate points each marked by a circle; these points being five miles apart from each other laterally, and five miles from the river, the width of the latter being two miles.

Now, if the traffic should flow only between points directly opposite across the river, as for instance between A and A'; B and B', etc., the claim that the plan B offers the shortest haul would be fully justified. But the traffic is liable to flow diagonally across the river, in fact by far the greater part of it will do so as indicated by the lines in plan B, and if we assume that the amount of traffic is the same between any two points, we find that the average haul across the river is 18.6 miles for such a bridge and 17 miles for a plurality of tunnels. This difference in favor of plan B of less than 10 per cent in the average haul is too small to deserve serious consideration, in view of the great saving in cost by the use of a single large bridge.

When we consider the high speed of motor-driven vehicles, distance is of less importance than the delays due to traffic interference. It should be explained, here, that a variation of the distances shown in our diagram does not materially affect the truth of this argument, nor would the use of six for three tunnels.

It is true that plan A is inconvenient for traffic between points A and A' or between B and B'; but such traffic represents a comparatively small portion of the whole, and in the case of the Hudson River can always be taken care of by the existing ferries.

As regards congestion in the street system, a glance at the two diagrams must convince us that plan A is far superior; the lines of traffic do not intersect each other in the street system, and hence all the delay which arises at crossings is avoided. In plan B the lines of traffic intersect each other frequently, with a proportionate slowing up of the cross-river movement.

Avoidance of congestion at the entrances and exits is entirely a matter of proper planning and traffic regulation. The traffic must be distributed directly into a sufficient number of streets in such manner as not to cause excess traffic in any one street and to avoid crossing of traffic going in different directions. That is perfectly feasible no matter what the traffic capacity of the crossing. A single tunnel may safely discharge all its traffic into two avenues; a great bridge may require a dozen street outlets, either of which, however, would not carry a greater traffic than those that were fed by the tunnel. Such outlets can be secured by means of inclines, or ramps, that discharge into the various avenues that are intersected by the bridge approaches.

Sounding by Sound

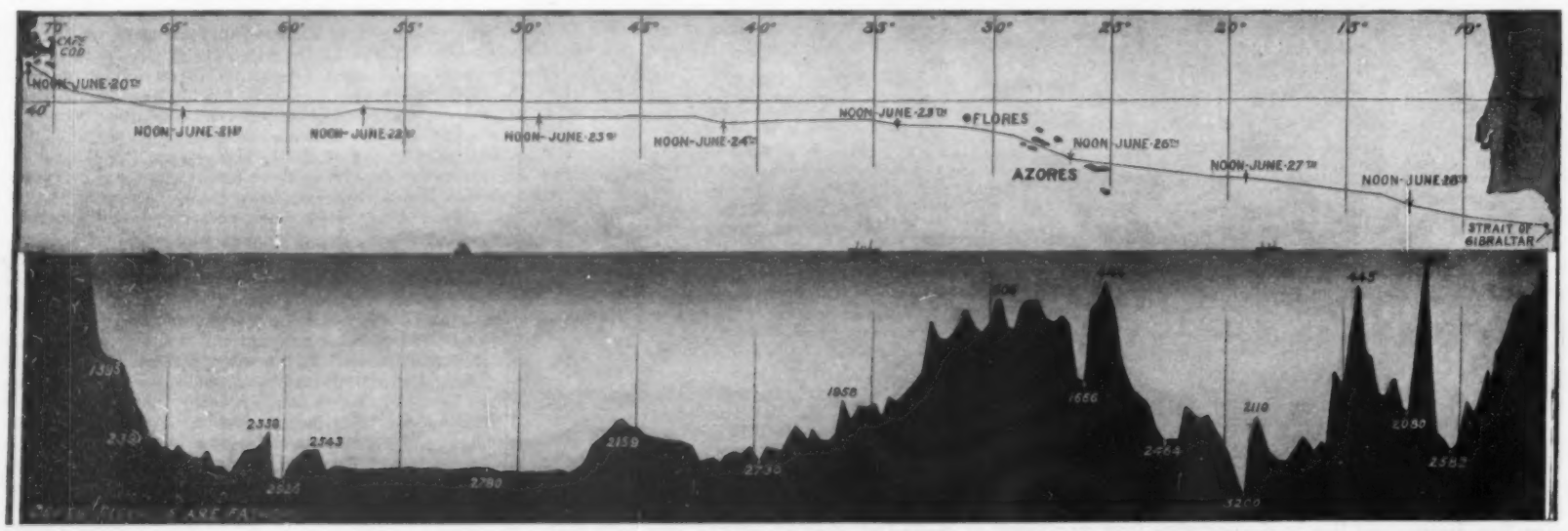
SONIC sounding is rendered possible by the fact that sound vibrations, passing through water and striking a solid surface, are returned as an echo to the source from which they originated. Working upon this principle, Dr. H. C. Hayes developed, at the Engineering Experimental Station, Annapolis, a method of determining ocean depths, which has been used by ships of our navy in some very successful and striking demonstrations. Of these, the most notable was a series of soundings taken aboard the U. S. Destroyer "Stewart," while en route from Newport, R. I., to Gibraltar, from June 22 to June 29, 1922.

The vessel was equipped with the Submarine Signal Company's Fessenden sound oscillator for sending out sound signals. The sound vibrations passing through the water rebounded from the ocean bottom, and were received in an M. V. Hydrophone Sound Receiver, with microphone units, which was mounted in the hull of the "Stewart" beneath watertight blisters. The depth was determined by noting the elapsed time between the sending out and the receiving of the signals. One half of this time, multiplied by the velocity of the sound waves, gave the depth at any particular point.

In the nine days occupied by the trip the "Stewart" took 900 soundings, the speed of the ship being 15 knots. The results of this very successful experiment are represented on the accompanying drawing, in the upper part of which are shown the coasts of the United States and Europe, with the course sailed between them; while below is shown a continuous profile of the ocean bottom, as determined by the Sonic soundings.

Very interesting is this view of the mountains and valleys of the Atlantic, showing at the left the so-called "Continental Shelf," where a drop was made to 1395 fathoms, and then to 2391 fathoms. There is a more or less gradual rise to a lofty summit at 25 degrees west longitude, which reaches to within 444 fathoms of sea-level. Then comes a precipitous drop of 2464 fathoms, and later to 3200 fathoms, a depth of over 3½ miles. Between that point, to a point off Cape Trafalgar, where the soundings were completed, there are two high points showing depths respectively of 445 and 145 fathoms.

The Navy is to be congratulated upon the success of this new and valuable aid to navigation. It is the latest in a long list of similar technical investigations that have been worked out to a demonstration, and given to the world by the Navy Department. The value of the device lies in the rapidity with which the navigator can take soundings as compared with the old method.



Profile showing depth of the Atlantic between America and Europe, as determined by the time taken by sound waves, sent out by U.S.S. "Stewart" to strike the bottom

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Milk bottle opener. Keeps fingers clean and milk sanitary

Sanitary Milk-Bottle Cover

ORDINARILY the removal of caps from milk bottles involves first hunting up some sharp instrument for prying up the stiff pasteboard, and if this instrument happens, as is often the case, to be the tine of a fork the latter is quite apt to be damaged in the process. Moreover, in this process milk or cream may be spattered on the clothing and table linen, while the cap, when removed, is apt to be placed where its subsequent replacement on the bottle carries disease germs into the portion of milk not yet used.

Therefore a new device which is made of spring metal and is designed to be snapped around the mouth of the bottle will be of value to those who, for one reason or another, desire to use milk in small quantities at a time directly from the bottle. A spring clip carries, by means of a hinged attachment, a curved arm ending in a sharp hook which is thrust through the pasteboard cap. This not only lifts it out but continues to act as a handle for raising the cap like a lid until the whole content of the bottle has been used. The little device improves the appearance of the naked bottle and may be quickly removed by a slight pressure.

The Bachelor's Washboard

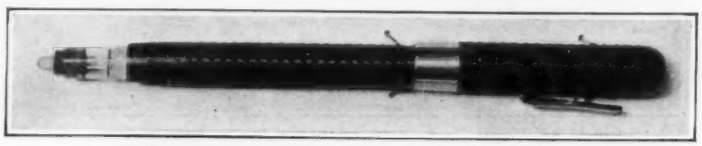
A SMALL tin corrugated washboard that fits either hand will find a ready place in the heart of the lonely bachelor who wishes to wash out small garments both within a brief time and without attracting the smiling attention of others not so singly blessed—or otherwise, according to one's viewpoint. Small as it is, there is nothing else that is toylike about it while its small size will be in the eyes of many its strongest advantage. For similar reasons, and because it will clean fabrics as efficiently as the larger style of washboard, lady bachelors will appreciate this simple device. Its use requires, instead of a tub, only a small basin and it is admirably suited to use in conjunction with the ordinary lavatory. To mothers of infants it will be a boon while the average housewife is sure to bring this convenient article into frequent use.

There are many occasions when only a single garment is to be washed and the presence of such a literally "handy" device insures that a good job will be done without the bother of hunting up large tubs, etc.

Small tin washboard facilitates quick work on small washings

Fountain Pen Eraser

AN ingenious inventor, Thomas W. Cappan of Newark, N. J., has combined with a fountain pen an ink eradicator of the sort which employs an acid capable of dissolving ink. At the top of the pen and protected by a hard rubber cap, is a tiny vial of acid. This is retained by a rubber cork bearing a glass tip for applying the eradicating fluid.



Fountain pen carries ink erasing fluid in head

Painting Galvanized Surfaces So It Will Be Permanent

THE average man in the street is quite familiar with the peeling off of paint on the metallic front of the bay windows or cornices of houses. These are usually made of galvanized sheets bent into the required form and then painted. But the paint does not adhere permanently as it does to wood and stone and soon peels off leaving an unsightly surface.

A large paint company, after a long series of experiments, has determined the cause for this and a remedy. The cause of the peeling is an interesting story.

Before going into the experimental field, the company collected as much data as was available on the subject. It found that it was generally believed that the paint did not hold to galvanized iron due to the "greasy" nature of the surface. Many samples of galvanized iron were examined for grease, but no grease was discovered. Samples of galvanized iron were then chemically treated so that it would be impossible for any grease to be present, but it was found the paint came off of these chemically treated samples just as readily as if they had not been so treated. An old artist then called attention to the fact that for years painters had used zinc palettes on which to mix their colors, because they had found that the paint would not stick to the zinc, and even after drying, the paint could be so easily removed with a palette-knife.

These facts, coupled with those discovered, by a careful examination of old painted test pieces of galvanized iron, clearly show that it is the property of zinc or zinc-coated iron or steel (galvanized iron) not to hold paint, irrespective of what kind of paint it is, and that this property of zinc is due, under weathering conditions, to the zinc's combining with the oils of the paint to form a soap. This layer of soap is formed between the metal surface and the paint. It prevents the paint adhering to the metal and as might be expected when the metal expands or contracts the paint flakes off.

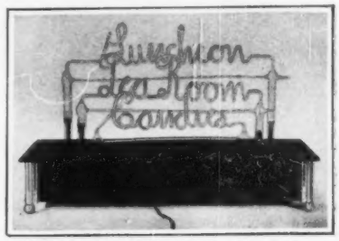
As soon as these facts were established the company immediately turned its attention to the question of preventing the formation of the soap film so that the paint would not peel. In an effort to answer this question, hundreds of test pieces were painted with various pigments ground in oils and varnishes; chemicals were mixed with paints; but all gave a negative result. Chemical solutions were then applied to the galvanized iron, for the purpose of depositing various metals on the surface, such as silver nitrate, copper acetate, platinum chloride, etc. The results obtained by this method were at first very encouraging, but finally very discouraging, for it was found that the metal deposited was invariably electro-negative to the zinc.

It then occurred to the company that if the paint could be insulated from the zinc by a non-metallic material, which would be firmly attached to the zinc and to which the paint would strongly adhere, the problem would be solved. The laboratory was instructed to spare neither time nor expense to find such a material, and after many months was rewarded with success by the discovery of a chemical solution which produced ideal results. This material was named Lithoform due to its peculiar property of producing a stone-like surface on the zinc coating. It is clear, thin non-volatile liquid of such chemical properties that when applied to the galvanized iron it changes the outer surface to a stony substance, which cannot be washed or chipped off and to which the paint strongly attached itself.

Whoever has passed through certain sections of our largest cities has seen thousands of buildings with metal cornices and false gables, many of which are an eyesore due to the peeling from them of paint. Therefore the discovery of a substance which prevents this spalling off tends to raise rental values of these buildings, as well as to change the appearance of whole sections of a city.

Vacuum Tube Script Sign

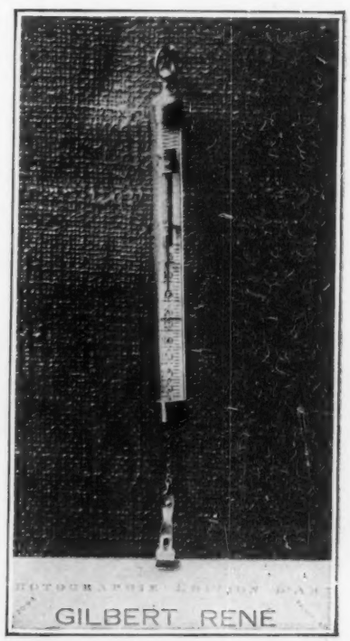
AN electric sign which carries its message in script form is a new product of a New York manufacturer. The desired letters or wording are made up into a continuous tube of glass bent into the necessary shape and the whole is mounted on a prepared composition base. It operates on the Geissler or vacuum tube principle and is now made practical for use on either direct or alternating current without alterations as well as for use on all commercial voltages. The letters or words are shown in a deep red or orange color and up to three script units or lines can be arranged in cascade formation. The current consumption is extremely low, only 8 or 10 watts being required for any length or number of units, in comparison with the 40 watts required for an ordinary 16-candlepower electric light bulb. This is largely accounted for by the fact that no noticeable heat is radiated, this kind of tube giving out a comparatively cold light. The guaranteed life of the sign is 2000 hours, although under average working conditions this is often prolonged by one-half or even more.



Cheaply operated sign which shows brilliant orange light

The Smallest Letter Weigher

A SMALL spring scale of French origin has for its purpose the weighing of letters in order to be sure of placing on them the correct amount of postage. The device, which comes in a protecting tube similar to the case of a fountain pen, consists of a spiral spring attached to the inside of a glass tube. This is connected by means of a tiny chain to a pendant clip for holding the letter or object to be weighed. A small pointer indicates the weight on a graduated



The smallest letter weigher in the world

Details of essential parts of new oscillating valve engine

scale within the tube. The little instrument has a ring at the upper end and may be conveniently hung from a hook or nail.

A New Automotive Engine

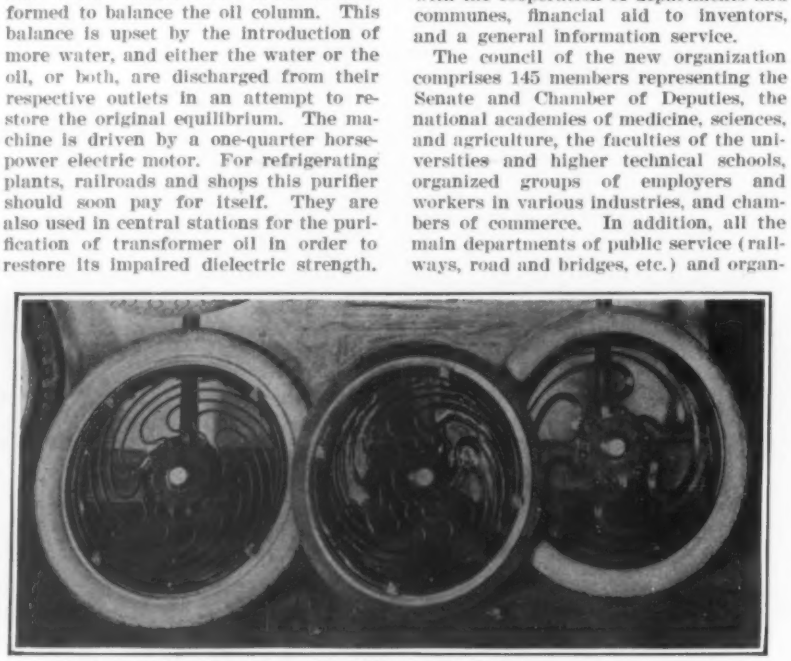
IN spite of the frequent appearance of variously conceived internal combustion engines in an effort to do away with the regular poppet valve and sleeve valve types, no appreciable inroad seems to have been made on the supremacy of the latter as yet. Regardless of the fact that inventors of various devices designed to replace the valves now most commonly used, claim that the unwillingness of the public to change to their discoveries is due to inertia, the fact remains that the public is as willing to accept a new invention of really proved and meritorious worth as the manufacturers are eager to make it.

Again we have to report a new type of motor, in which the operation of admitting and exhausting the gases is controlled by a cylindrical, annular, oscillating valve actuated by a rocker arm which is linked to the half-time shaft. This has small cranks instead of the usual cams. Heat losses in this motor are economized by having the intake charge pass through the same port which has just been heated by the exhaust gases. It is claimed that the lubrication is improved and that the motor is "super-efficient." Practically the only wear is said to be on the port lapping ring, and the loss occasioned by this wear is so slight as to be negligible.

Centrifugal Oil Purifier

AN oil purifier which works on a centrifugal rather than gravity principle is now made by a Goshen, Ind., manufacturer. Resembling in appearance, superficially at least, a cream separator, the machine makes its separation of water and dirt from the oil by means of the familiar U-tube, which is revolved at a high rate of speed. The difference in specific gravity of the oil and that of the water causes the water column formed to balance the oil column. This balance is upset by the introduction of more water, and either the water or the oil, or both, are discharged from their respective outlets in an attempt to restore the original equilibrium. The machine is driven by a one-quarter horsepower electric motor. For refrigerating plants, railroads and shops this purifier should soon pay for itself. They are also used in central stations for the purification of transformer oil in order to restore its impaired dielectric strength.

Oil purifier which works on powerful centrifugal principle



Spring steel spokes increase resilience and add to appearance of car

Another Spring Wheel

THE number of spring wheels designed to replace rubber tires is almost legion, but a new spring wheel intended to be used in connection with ordinary rubber tires is the invention of Wm. J. Beisel of New York. In this design the ordinary straight spokes are replaced by spring steel spokes curved in the outline of a sickle. The group of springs thus brought together combines in the form of a whorl whose appearance is highly attractive, especially when in rapid motion. The inventor states that the new wheels, in addition to adding resilience to the vehicle, prolong the life of its many parts by saving it from road-shocks and from the sudden shocks of transmission. In case of collision they act as a shock breaker, and there is enough sidewise "give" in them to take up a blow such as that occasioned by bringing up against a curb after skidding. Applied to trolley cars they prevent the absolute gripping of the brakes and the development thereby of flats on the periphery of the wheels.

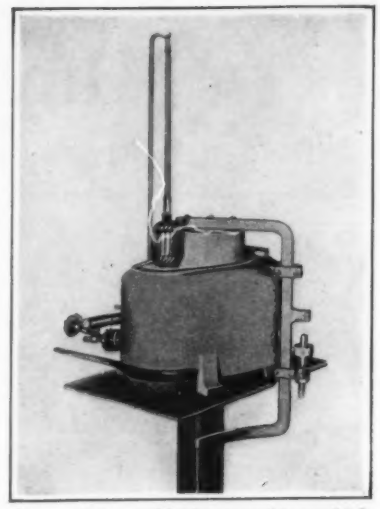
A National Bureau of Scientific Research for France

THE French government has just taken the important step of creating a national bureau for the encouragement of scientific investigation, with particular reference to industrial inventions. Ever since the war, and especially during the past year, the French press has been active in calling the attention of French industrialists to the superior organization of industry in Germany both before and since the war, and to the lack in France of any systematic study of industrial problems on their scientific side, and, in particular, to the lack of encouragement for inventors in carrying on their investigations or placing their inventions on the market.

The national bureau which has just been established, known as the National Office of Scientific and Industrial Researches Relating to Inventions, is attached for administrative purposes to the Ministry of Public Instruction. Its work is intended to include not only the stimulation and encouragement of inventive talent in all departments of French industry, but also assistance to manufacturers and others in examining the scientific problems which arise in connection with their industries, the establishment of expositions and prizes, the creation of experimental laboratories with the cooperation of departments and communes, financial aid to inventors, and a general information service.

The council of the new organization comprises 145 members representing the Senate and Chamber of Deputies, the national academies of medicine, sciences, and agriculture, the faculties of the universities and higher technical schools, organized groups of employers and workers in various industries, and chambers of commerce. In addition, all the main departments of public service (railways, road and bridges, etc.) and organized groups of agriculturalists are given representation.

The president of the new bureau is M. Louis Loucheur, an engineer of high standing and formerly Minister of the Liberated Regions, to whom the great progress which has been made in the restoration of the invaded departments of France is largely due. The council also includes M. Paul Appell, rector of the University of Paris, M. Paul Painlevé, professor of mathematics and former Premier, Professor Emile Picard, secretary of the French Academy of Sciences and of the International Research Council, Mm. André Citroën, André Michelin, and Louis Renault, well known leaders in the automobile industry, and others.



Commutator soldering machine which does neat uniform job on all joints with single operation

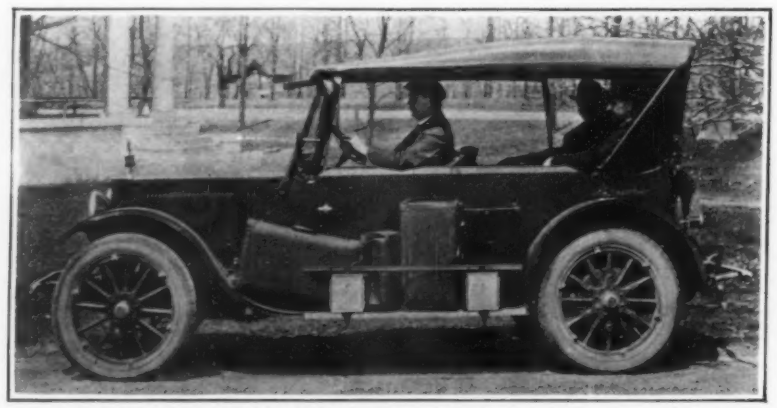
A Commutator Soldering Machine

A MACHINE which solders all of the joints of a commutator in one operation has been brought out by a St. Louis manufacturer whose claim is that it does better and more uniform work than can be done by hand soldering. In this process the commutator is placed in a stationary position above the pot of solder and the latter is elevated by means of a foot treadle until an accurately adjustable stop is met. This prevents the solder from flooding other parts of the work. Other advantages claimed are that the solder is automatically cleaned of dross as it is raised to the joints, no solder is wasted by dripping, and the ring insulation is not injured. Less skill is required to use the machine efficiently than the common soldering iron. It is mounted on a heavy metal pedestal and provided with gas burners for heating the solder. It is, of course, equally applicable to the soldering of rotors of any sort and is said to have well withstood the test of daily operation.

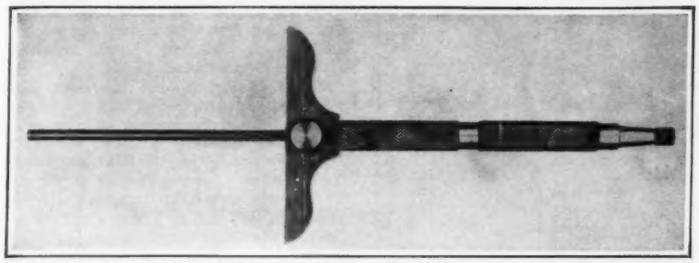
Such a machine largely disposes of the human equation in the performance of operations of the sort which, because of their routine nature, tend in the hands of many workmen to be more or less carelessly done after the workman has become fatigued or if the lighting is poor. In addition, the invention will prove to be a money saver.

A Trim Luggage Carrier

A NEW and extremely neat luggage carrier for the automobile running board which is the product of a Springfield, Ohio, manufacturer, acts when folded, as a pair of running board mats. This device consists of two folding steps which are connected by a section of angle bar. It can be removed



Attractive luggage rack which combines functions of step when folded



This device is a spring depth gage, for accurate machine work, and is especially useful in measuring depth of drilled holes

or replaced in a jiffy and will be welcomed by the car owner who prides himself on the possession of a car of neat appearance.

This device is one of many ingenious luggage-carrying devices which have appeared of late. More and more the automobile is coming to be used for long trips, and the popular sport type of car, with its trunk or luggage carrier at the rear, is an indication of this fact.

A Spring Depth Gage

A WELL-KNOWN firm of tool makers has recently introduced a spring depth gage which is particularly adapted to taking quick measurements. The spring in the barrel automatically forces the rod downward and the clamp screw locks the rod in position. The capacity of the gage is three inches. It will be noted in the accompanying illustration that the gage has an extra long base, namely, 2½ inches. The base is four-tenths inch thick and the rod is one-eighth inch in diameter. The base and the contact point of the rod are not lapped but are tempered and ground. The contact end of the rod is ground square instead of convex, in order to make it easier to manipulate when measuring from a plane surface to a very narrow shoulder. The gage is especially useful for measuring the depth of drilled holes.

Giant Steel Arms for Handling Logs

AS far as labor-saving machinery is concerned, Germany is not far behind the United States. These columns have from time to time presented interesting kinds of labor-saving machines and devices used in Germany, and we now have the huge pair of steel arms, shown in the accompanying illustration, to add to our published collection. This huge pair of arms is used in the handling of loose logs. In general principle the operation is quite like the well-known clam shell bucket, except that it is opened at both ends.

A German variation of the clam shell bucket for the handling of logs

Making the Electric Toaster and Cooker One

AN innovation in electric toasters has now made its appearance on the market, in the form of a combination

This device toasts both sides of a slice of bread and cooks at the same time

toaster and cooker which is shown in the accompanying illustration. This device cooks at the same time that both sides of the bread are being toasted. The toast rack can be removed when baking and cooking can be done at the same time. As will be noted, the design and construction are such that the device is readily taken apart for cleaning.

Combination Hand-Vise for the Home and Shop

THE new hand vise shown in the accompanying illustration will prove exceptionally useful around the home as well as in the shop. The vise is furnished with a clamp, permitting its use as a small bench vise as well. Thus used, it may be adjusted to any point in a circle to suit the convenience of the user.

A new design feature of especial interest is the ball end handle for tightening the jaws instead of the wing nut commonly used. Extra leverage is thus made possible. Jaws are of drop-forged steel, tempered and polished. The capacity of the vise is 1½ inches.

Breakage of Watch Springs

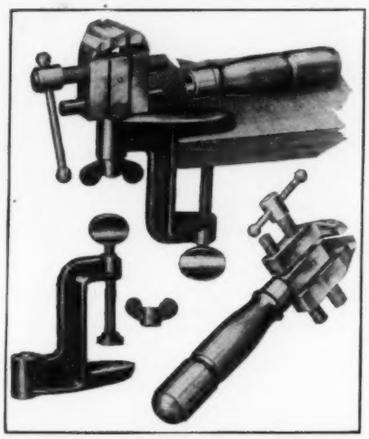
S. R. WILLIAMS, of Oberlin College, has investigated the cause of the spontaneous breaking of main springs in watches, a common and annoying incident. It appears that watch repairers are inclined to the view that such breakages are seasonal, occurring principally in the warmer months. Williams was permitted to examine the records over several years of two firms doing a large repair business, and on plotting the results found in both cases a peak in summer fairly coincident with the peak of the graph showing the occurrence of thunder storms. There was, however, in both cases, a slight dip about mid-July, which has been ascribed to the absence of many persons on vacation. Experiments were made, the most of which indicate that the breakage is not due to heat but to moisture. Williams thinks that the moisture acts by starting rusting points which weaken the spring at those points. In an experiment, in which 56 samples were tried, equally divided between two well-sealed jars, one containing dry and the other moist air, 17 springs broke in the latter and none in the former. It was also found that oiling the spring diminishes very markedly the liability to break.

A Spotlight That Uses the Windshield as an Auxiliary Lens

THE spotlight is a proved necessity to the motorist driving at night for spotting the roadside or ditch when meeting another car. Under the old methods it is difficult to derive the full benefit of a spotlight and have it properly set when meeting another car, because it is outside the car—often out of reach and therefore out of control.

A new spotlight or driving light has been developed to overcome the dangerous hazard of driving blind while passing other cars. The new light is designed to permit the motorist to place the light inside the windshield, and thus places the light within easy reach of the driver and under his control at all times.

The new light gives a full round ray of light at every angle and it does not interfere with the movement of the lamp in any way and can be turned more easily in any desired direction than though it were outside the car. It can be allowed to turn easier when inside and stay put than when outside for the reason that it is behind the windshield, out of the wind, which often blows the



This little combination hand vise may be made to serve in a great number of ways

lamp out of position when on the outside.

The driving light serves as a combination driving light and trouble light as it can be very quickly detached by merely turning a thumb screw which releases the lamp from the bracket, for use in or around any part of the car.

A spot light with telescopic hood, which throws its beams through the wind-shield

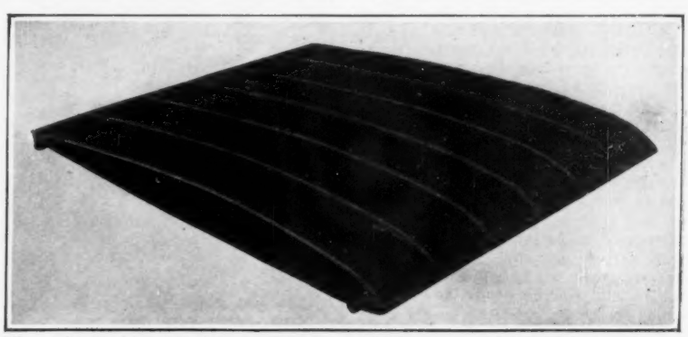
The inside spotlight is designed not to glare approaching drivers unless turned directly on them. The light is set back in the deflector and eliminates the side glare.

The spotlight has a telescopic hood which can be lengthened or shortened or turned from side to side or at any angle for focusing. It is fastened by means of a bracket so that the hood fits snugly against the windshield.

An Airplane Radiator Made Like a Wing Surface

ELSEWHERE in this issue there appears a description of the new Curtiss wing type of radiator, which has made for the considerable reduction of head resistance and the consequent marked increase in flying speed. We now present a section of the sheet-brass wing covering, showing the wing radiation system perfected by the Curtiss engineers, as a supplement to the article already mentioned. It will be noted that the hot water is pumped from the engine to pipes running laterally in the front edge of the wing, and is forced through small channels in the sheet brass to a similar pipe in the rear edge, from which the water is returned, cooled, to the motor. As the radiator takes the place of the ordinary wing covering, the head resistance, which is a serious handicap with the old-fashioned radiator, is eliminated.

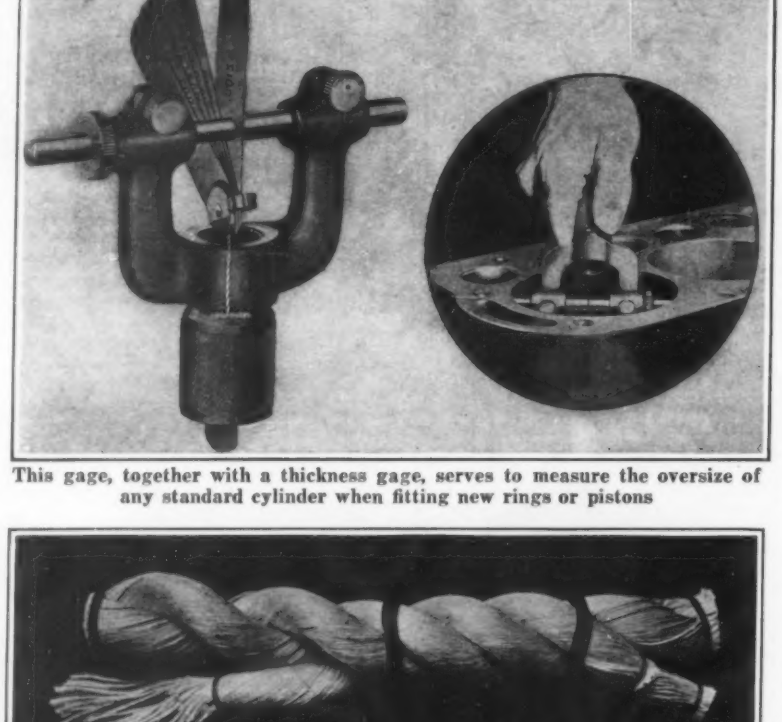
The wing type radiator is well in keeping with present-day aeronautical developments. Every effort is being exerted toward the reduction of head resistance, so that many of the latest planes have practically every member properly stream-lined, thus making for a most fantastic appearance. Some of the European machines use the hollow drum-type radiator to reduce head resistance.



Not only is this sheet-brass member available as a highly efficient radiator, but it serves as part of the airplane wing, as well

A Device to Measure Oversize of Any Standard Cylinder

DESIGNED on a new principle for everyday use in a repair shop, the gage shown in the accompanying illustration measures the exact oversize of any standard cylinder when fitting new rings or pistons. It consists of a fixed pin and an adjustable pin mounted in a holder. When together, the combined length of both pins equals the exact standard size of the cylinder to be measured. In measuring the oversize the adjustable pin is unscrewed until the device fits snugly in the cylinder. The opening between the pins may be measured with a thickness gage and the result is the oversize of the cylinder. The device may also be used as a standard oversize gage by inserting the required blade of a thickness gage between the pins.



This gage, together with a thickness gage, serves to measure the oversize of any standard cylinder when fitting new rings or pistons

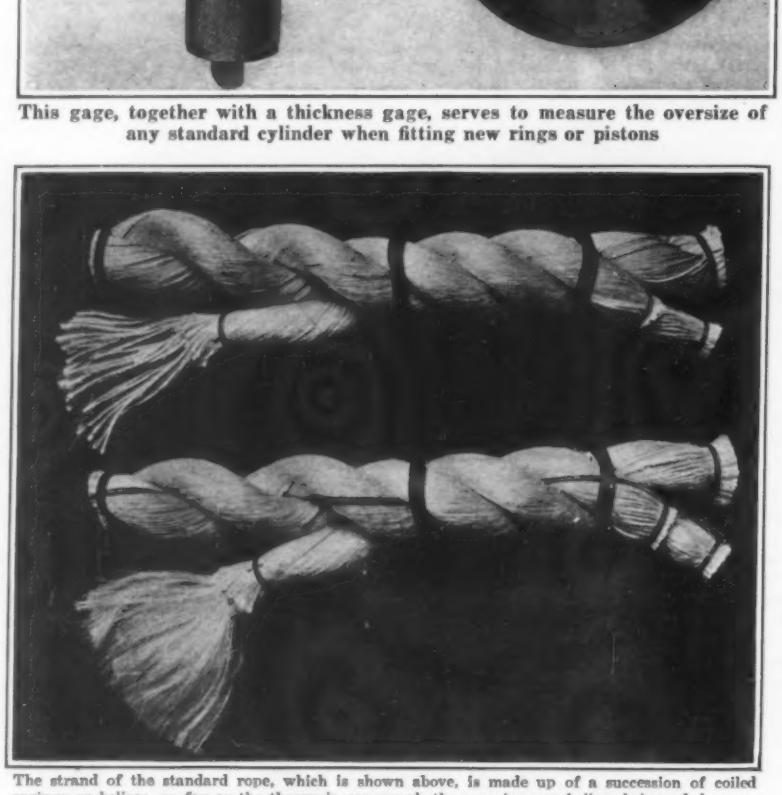
Something New in Rope

EVER since the time of Tut-ankh-Amen, the making of rope has not changed to any marked degree. True, machinery has been introduced in the making of rope, but the basic structure has remained the same. Now, at last, we have a really new rope for which many advantages are claimed.

Let us review the old type of rope, in order better to appreciate the advantages of the new type. Starting with the bale of fiber, we find it is opened and the hanks are fed through various machines functioning to comb the fiber into a continuous ribbon known in the trade as "sliver." This process is continued until the ribbon or sliver is uniform and of the proper size for spinning. It is then sent to machines known as "jenneys" which spin the sliver into yarn. This yarn, wound on bobbins, is then sent to the "formers"—machines which form or twist the yarns into a strand. Keep in mind the fact that the strand is made up of layers of yarn twisted around each other; the yarns composing the outer layer are known as "cover yarns," while all yarns below this layer are designated variously as "center," "inner" or "inside" yarns. These strands are then "layed"—twisted around one another—to form the finished rope.

With this brief description of the ordinary rope structure in mind, the next step will be to examine the manner in which the forces to which rope is subjected act upon the component parts of the rope. The theoretical basis for any discussion of this kind would be the curve known as the helix. It is not our purpose here to go into any mathematical or technical details, however, but rather to present this phase by easily visualized analogies and in the simplest possible manner. For our purpose, then, the helix may be visualized in the form of a coiled tension spring. If one can picture a number of tension springs of decreasing diameters, but of equal "pitch," coiled concentrically—one within the other—one has a fairly accurate picture of the various layers within a strand of ordinary rope. (To simplify matters, we are considering a strand only and not the rope as a whole.)

Now then, holding one end of each concentric spring in one hand, we can imagine ourselves extending the set of springs by pulling out on the other set of ends. The spring in the center, being of the smallest diameter, will have the least length of wire and will be the first to pull out straight for its entire length. No further extension of the outer springs can be made until the wire of this center spring has broken and released the pulling hand. The further progress of the pulling will be arrested by the second spring straightening out, and when that is broken the pulling operation may be extended to the third, and so on until the last or outer spring. Thus we arrive at a most important theory in the structure of ropes, namely, that the yarns in a strand do not pull as a unit but rupture successively layer by layer, beginning with the shortest inner yarns.



The strand of the standard rope, which is shown above, is made up of a succession of coiled springs or helices, so far as the theory is concerned, these springs or helices being of decreasing diameters but of equal pitch, coiled concentrically or one within the other. To simplify matters we are considering a strand only and not the rope as a whole. The new type of rope, shown below, has the proper number of slivers united to form one large sliver, duplicating in weight all of the center yarns of a strand

The old type of rope, shown above, and the new type shown below, partly unwound to show distinguishing features of each type

This formidable looking machine cracks fifteen tons of walnuts daily, without damaging the kernels

Now that the ailment has been diagnosed, let us turn to the cure. Knowing that ordinary rope cannot be more than 60 per cent efficient, how can a rope be constructed to be, say, 80 per cent efficient. The solution is evident—so make the rope that all yarns will be of the same length. And that is precisely what H. V. Whitlock of New York City, assisted by W. L. Faust, accomplished in the new rope which they have developed.

In the new rope the proper number of "spinning slivers" referred to above, are united to form one large sliver duplicating in weight all of the center yarns of a strand. These combined slivers are then fed as a unit, unspun, to the former, and the cover yarns are placed around them. The strand made in this manner corrects the faults of the strand composed wholly of layers of yarns in that the stress-bearing fibers are all of the same length—all parallel to each other, and parallel to the axis and to direction of loading of strand.

The new rope, simple as it appears, has numerous marked advantages over the usual type of rope. First of all, its tensile strength is remarkable. One case will suffice to make a comparison. After a number of tests on a six-inch, three-strand rope, it was found that the regular structure rope averaged 35,730 pounds, while the new rope averaged 46,770 pounds.

A Machine Which Cracks Fifteen Tons of Walnuts a Day

ULTIMATE consumers accustomed to shattering the shells of walnuts with hand-manipulated pincers as a means of extracting the kernels therefrom—tedious job that it is—will doubtless marvel at the announcement of the invention of a machine having the capacity of cracking fifteen tons of walnuts daily. Numerous preceding attempts to devise successful mechanical means for depriving walnuts of their shell-like coverings without injuring the kernels proved futile; it remained for the California Walnut Growers Association of Los Angeles, Cal., to develop a satisfactory machine.

Walnuts subject to undergo a cracking process in this large double-acting mechanism are admitted into a hopper by means of a conveyor. Located in front of the hopper, with the upper ends on a level with the upper edge of the trough, are alternately arranged feed tubes. The latter are almost vertical in position and by alternating with and having their upper ends in alinement with tubes curving forwardly and downwardly in a compound curve the lower ends of the tubes are in a staggered relation with the upper intake of the cracking jaw.

Just beneath the discharge ends of the aforementioned tubes are pairs of downwardly and inwardly-tapered stationary and movable jaws, which are V-shaped in cross-section. Each pair of these jaws forms a downwardly reduced passage into which nuts, singly, obtain passage from the tubes. "Stationary and movable jaws," is a phrase used advisedly, since they are arranged in parallel rows, one-half of which are in a fixed position and the other half movable. The latter are assembled on a cam shaft, adjustable in motion; a condition which permits of the accommodation of walnuts of varying sizes.

The walnut is admitted passage through the feed tubes into the V-shaped jaws and through the action of a cam shaft the kernel is separated from its shell-like covering. Once the cracking process has been completed, and the shaft is released from the cam, the jaws are opened by force of springs. The shelled walnuts are then permitted passage into a hopper below, whence they are carried to a sacking device located at the end of this conveyor.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Machine Bearings of Limestone

THE proper lubrication of machine bearings is an important factor in the efficient operation of any machine. All sorts of devices are used to feed the oil or grease into the bearing and keep the shaft properly lubricated so that it is not subjected to the wearing action of friction and so that not a minimum of power is lost in the transmission. A new type of bearing has been introduced in Germany, which consists of a limestone lining, enclosed in white metal. The metal is first poured into a mold, surrounding a solid piece of limestone, which is then drilled with a diamond point tool to form the opening through which the shaft is introduced. Limestone is porous and absorbs the oil that is used in lubrication and in a comparatively short time the limestone becomes very smooth, being highly polished by the continued rubbing of the metal of the shaft against it. It is evident that in time the amount of friction between the limestone and the shaft is reduced to an absolute minimum. This type of bearing has been used with great success on car wheels, and it has been found that the ordinary type of bearing, which is used for this purpose and which has a life of from 6,000 to 7,000 miles, can be replaced to good advantage by the limestone bearing, which has lasted in certain cases for an extended period of time during which the car traveled from 35,000 to 45,000 miles.—*Chemical Trade Journal*, 1922, page 701.

Gunite as a Fire Preventive

BUREAU of Mines tests at the University of California have indicated that Portland cement gunite will stand up in a hot fire. This is an important consideration as mines fires could be prevented by the use of this material. It is recommended that all underground permanent timbering in mines as well as mule barns, ventilation doors, power stations, hoist stations, timbered haulage-ways and fan stations can be effectively fireproofed by this method. Gunite coatings can also be used to good advantage on transformer houses, assay offices, powder magazines and other surface building around a mine.

New Specific Against Diabetes

A PRODUCT by the name of isulin has been prepared by Canadian biologists in Toronto, which it is claimed is a specific against diabetes. The preparation is made from the pancreas of cattle, sheep and swine.

Making New Phosphorescent Salt

ZINC sulphide, which has a greenish phosphorescence, and which can therefore be used for the many purposes for which phosphorescent salts are utilized at the present time, is made in accordance with a new process, described in the *Ber. d. chem. Ges.*, 1922, pages 3988-3989. Equal weights of pure zinc sulphate and acetate of soda are dissolved in hot water. Then a stream of sulphuretted hydrogen is allowed to flow into the solution, which is kept constantly hot, until the zinc has been precipitated completely. After the zinc sulphide has been allowed to settle, then the supernatant liquid is removed by siphoning. The sulphide is washed with hot water by decantation. It is then filtered and washed thoroughly once again and finally dried on the water bath. Then about 200 parts of the zinc sulphide, prepared in this manner, is uniformly moistened with a solution containing 20 parts of magnesium chloride, 10 parts of calcium chloride, 10 parts of strontium chloride and 10 parts of crystallized barium chloride, all being dissolved in 22 parts of water. Before this solution is added to the zinc sulphide, it is mixed with 10 parts of a solution of ammonium tungstate, which contains 0.004 gram of the salt per cubic centimeter. The mixture of the prepared chloride solution and the zinc sulphide is evaporated to dryness on the water bath with constant agitation, and the dried mass is then transferred to a crucible and heated in a gas muffle furnace. The heat is applied gradually so that the crucible becomes red hot within an hour's time. The crucible is maintained at this temperature for about 30 to 40 minutes and then the crucible is allowed to cool while still in the oven to the room temperature. The soluble salts are removed by decantation and washing with water. The washed sulphide of zinc is then dried on the water bath.

Deterioration of Calcium Arsenate in Storage

THE Department of Agriculture has recently made exhaustive experiments to determine whether there is any deterioration of that important insecticide, calcium arsenate in storage. It was found that when the arsenate is packed in containers that were not airtight, the salt absorbed carbon dioxide from the air with the resulting formation of small amounts of water soluble arsenic. Water soluble arsenic is injurious to the foliage of the cotton plant. There was no change observed in calcium arsenate storage stored in air-tight sheet metal drums over a period of 20 months. Hardwood barrels were also very good for preserving the chemical in its original condition. Veneer drums, both unlined and paper lined, and sugar barrels, paper lined and unlined, were not so satisfactory when calcium arsenate was kept as long as 20 months. For further details see Department Bulletin No. 1115.

New Moth-Proofing Agent

A NEW process of treating woolen fabrics to moth-proof the same is the subject of German Patent No. 357,063. The fabrics are subjected to the action of alpha-tetralon in the vapor form. The chemical name of this substance is alpha-tetrahydronaphthalene ketone. The protective action of this substance is greater than that of the chlorinated aromatic compounds, since it is less volatile. The product is obtainable as an emulsion in soft soap or in the form of a powder, pellets or tablets. Paper and fabrics may be treated with solutions of alpha-tetralon in petroleum spirit of high boiling point.

Direct Reproduction of Half Tones on Lithographic Plates

FRENCH Patent No. 539,639 is concerned with a process of reproducing direct images on lithographic stones, on zinc or offset work, without it being necessary to engrave the half tone. The process consists essentially of producing an image on sensitized paper, which has the following composition: Two grams of ammoniacal citrate of iron, 0.8 gram of potassium ferri-cyanide, 0.2 gram of potassium bichromate, 0.2 gram of carbonate of soda and 20 cubic centimeters of water. Any positive may be used; for example, a blue print, or a film or a photographic plate, which are fastened in the printing frame.

After the sensitized paper has been exposed for a sufficient length of time, it is applied on a special paste which has the following composition: Gelatine 1000 grams, water 5 liters, yellow ochre 200 grams, ox-gall 750 cubic centimeters, pure sulphate of iron 50 grams and sulphate of manganese 30 grams. The picture is transferred in this manner. After this has been accomplished the picture is inked by means of an ordinary roller. A print can then be taken on a piece of paper. Then the picture is fixed either on a lithographic stone or on a zinc plate or by the offset method.

New Refractory Product From Dolomite

DOLOMITE cannot ordinarily be used in the manufacture of refractory products, due to the fact that it falls into a powder in a short time. Even when it is mixed with tar it does not give durable products. But when it is mixed with alumina, the product is free from this objection. About 100 parts of dolomitic limestone, which has been ground to a fine, impalpable powder, is mixed with 10 to 20 per cent of its weight of bauxite. The mixture is then melted in the electric furnace. The product is just as refractory as pure dolomite and can be worked in various ways. For further details see French Patent No. 537,511.

Tantalum a Commercial Product

TANTALUM is a rare metal, which finds important use in the manufacture of different electrical instruments. It was imported into this country from Germany prior to 1914, but a process has been developed within the last year for its manufacture on a commercial scale in the United States. The metal is soft and easily workable and at the same time it is very resistant to wet corrosion. It is not attacked by any acid or alkaline solution with the sole exception of hydrofluoric acid. It finds important application in the manufacture of valves in electric cells and in the construction of electrolytic rectifiers in alternating current work.

Seasoning Wood by Ozone

WOOD must be seasoned before it can be used for many purposes, as in the manufacture of furniture. Natural seasoning of wood is a long process; in extreme cases it may take as much as two to three years. The ozone process accomplishes the same results within a period of a few weeks. If the wood is subjected to drying with hot air, the wood becomes dry but the starch in the cells remains unchanged. It attracts parasites and gives rise to the formation of molds. When hot water or steam is used to dry the wood, then the same effect is secured as when the wood is over-dried and the cells are left empty. The wood is rendered brittle and lifeless. In the ozone process the wood is submitted to the combined action of gentle heat and ozonized air, which brings about simultaneous evaporation of water and oxidation of the organic constituents of the cell sap. Specially designed kilns are employed in the process; one type of kiln is continuous and the other is divided into compartments. The treatment takes from ten to fifteen days, according to the nature of the wood. In that period green wood can be converted into seasoned wood possessing all the characteristics of wood which has been exposed to the action of air for ten years. The physical properties are identical. No difference is detected by mechanical, chemical or microscopical tests. The process is being worked on a commercial scale in Paris.—*Jour. Soc. Chem. Ind.*, 1922, 547R.

Renovating Old Corks

OLD cork stoppers can be cleaned and softened by boiling them, suitably weighted, in a 5 per cent solution of sulfuric acid for 15 minutes. After rinsing several times in water, the corks are boiled in clean water for 15 minutes, and when cold they are placed in a 5 per cent solution of alum for six hours, and then dried in the sun for 2 to 3 days.—*Chemiker Zeitung*, 9-28-22.

Helium Cracked From Carbon

A TRANSMUTATION of the supposedly elemental carbon into helium has been accomplished according to a report, published in the *Oil Paint and Drug Reporter*, Jan. 29, 1923, of work done at the Sperry Gyroscope Research Laboratory. The transmutation was effected by means of the electric arc at a temperature of 5000 degrees C.

Activated Carbon With the Aid of Selenium Chloride

ACCORDING to *Chemical and Metallurgical Engineering*, Jan. 24, 1923, a new method of making a pure carbon at a moderate cost consists in treating charcoal with selenium oxychloride, a solvent for the hydrocarbons, removing the solution and washing the residue. The material that is obtained in this manner may be used for various purposes, such as an activated carbon in gas masks, or in the recovery of gasoline from natural gas. As a purifier material it may be used in the manufacture of dry-cell batteries or for electrodes.

Function of Magnesium in Fertilizers

RECENT investigations made by the Bureau of Plant Industry have revealed that the presence of magnesium in fertilizing compositions is necessary to the proper growth of the plant. The magnesium performs a definite function. Tobacco, corn and other plants are subject to a certain leaf disease, which is known to tobacco growers as "sand drown." In this disease the green and yellow coloring matter in the chlorophyll is affected and the leaf tissues are blanched. This blanching always begins with the older leaves. It has been found that this disease is due to the absence of sufficient magnesium in the soil or fertilizer. The trouble can be prevented by the addition of comparatively small quantities of magnesium salts in the soil, according to the Government authorities.

The Heavens in May, 1923

The Mechanics of the Meteor and Its Role in Everyday Astromony

By Professor Henry Norris Russell, Ph.D.

EVERYONE is familiar with "shooting stars"—those specks of light which dash swiftly across the heavens and vanish almost as we perceive them. Usually they are comparable in brightness with the more conspicuous stars, but occasionally great "fireballs" appear which far outshine Venus, and may even light up the whole landscape, like the Moon—though few of us have the good luck to see one.

It has long been known that these meteors are relatively near us—in the upper part of the Earth's atmosphere. Small bodies, pursuing each its own orbit about the Sun, after an independent existence of millions of years, finally find the Earth in their way. So long as they move in empty space they are cold and invisible; but the moment they enter the air their rapid motion is slowed, its energy converted into heat, and they blaze out for a few seconds, usually to be consumed, though a few big ones get through and fall as aerolites.

The meteorites which fall on the Earth's surface are composed usually of stone, or more rarely of iron. In either case they are dense, solid bodies, and we may well suppose that shooting stars are similar in nature. When two or more observers in different places get a good sight of one, it is possible to work out its true path, and it is thus found that meteors usually light up at heights of 50 to 100 miles, and disappear when they have come from 10 to 40 miles lower down, though usually at heights exceeding 40 miles. Their velocity is very great, averaging perhaps 25 miles per second—as might be expected from the nature of their orbital motion.

A very interesting discussion of these bodies has just been published by Professor Lindemann, of Oxford, who, by applying modern physical principles, has arrived at a most satisfactory explanation of the facts. When a small, dense, swiftly moving body enters the upper part of the atmosphere, where the molecules of gas are far apart, it will fling those which it strikes violently aside, in all directions, according to the angle of impact. At first these molecules will escape individually, but when the air grows denser, they will find other molecules in their way and bounce back toward the advancing meteor. As soon as this happens, the front of the meteor will be covered with a layer, or "cap" of compressed gas, continually increased by the impact of new molecules on the front, and as continually sweeping round to the sides and streaming away to the rear. The rapid compression will heat this gas and the surface of the meteor to a high temperature (Lindemann estimates it as about 2200 degrees Centigrade) so that the stone and iron will evaporate, and add their vapors to the mass of gas. This process continues until either the meteoric mass is completely vaporized away—if it is small—or, if larger, till its motion has been so much slowed down by the resistance that the heat dies away.

The moment at which the "cap" forms is that at which the meteor begins to shine. Before this, the air is so rarefied that it offers very little resistance to the small, dense projectile; but, as soon as it covers itself with a shroud of vapor, it stirs up the air more and, moreover, finds more air to stir up, so that the "friction" is much greater and more energy is turned into heat and light. Hot as the meteor is, the direct radiation from its surface probably accounts for but a small part of its light. Most of the energy goes into setting the molecules into such rapid motion that they knock electrons off one another, and so become ionized. The recombination which follows gives rise to the emission of light (as has often been explained in these columns) and Lindemann believes that much the larger part of all the original energy of motion is converted into light in this fashion.

From the observed brightness of a meteor, we may estimate the amount of the light-energy, and so find the original kinetic energy of the body and, knowing the velocity, also the mass. Lindemann takes as a typical shooting star one which appears at a height of 62 miles and disappears at 50 miles, after travelling downward obliquely in a 40-mile path at a speed of 25 miles a second. If such a meteor, to an observer 90 miles away, looked as bright as a first-magnitude star, it is easy to calculate that it must have been radiating energy during its brief apparition at the rate of more than four horsepower.

Even so, a very small mass, moving at so great a speed, would suffice to carry the necessary energy. One-tenth of a gram, corresponding to a speck of iron less than one-twentieth of an inch in diameter, is all that is needed. A lump weighing only two ounces would suffice to produce a huge fireball, which would light up a district a hundred miles across, almost like the Moon. Extraordinary as these conclusions appear, they are based on exact and sound reasoning—and they are fortified by experience, since aerolites, when they fall by night, appear like the great balls of fire which have so often been described.

Such large masses, on their mad career, may meet with more vicissitudes. They penetrate to lower levels where the air is denser, and the blast on the molten surface carries it off in spray, forming a luminous train. Unequal air resistances may set the mass spinning even so fast that it bursts asunder, as many fireballs have been seen to do. Finally, when the speed falls below eight or ten miles a second, the surface is no longer kept incandescent, the mass cools very rapidly, since the heating is so fast as to be only skin-deep, and the aerolite reaches the solid Earth with a low speed, like a spent cannon ball. The smaller particles, which never reach the ground, may be wholly consumed in the upper air before they have lost much speed, which again agrees with observation.

Professor Lindemann goes further and calculates that, at a height of sixty miles, when many meteors light up, the density of the atmosphere is about 1/120,000 of that which prevails at the Earth's surface. Though we would commonly call this a good vacuum (unless we were making X-ray tubes, or the like) there are plenty of air-molecules left at this height, more than three million billions of them per cubic inch, so that there is matter enough there to act upon the meteors.

Previous calculations had made the density at this height much lower, and the difference means that, at this elevation, the temperature of the air must be higher than has been supposed—indeed, much like that at the surface, instead of about 60 degrees below zero, as it is at heights of from ten to twenty miles. Lindemann suggests that this may be explained by the presence of ozone in these high layers. We know that it is somewhere above our heads, because it absorbs very strongly with ultra-violet light from the Sun and stars, limiting the observations of the spectroscopist in a very serious fashion, and that it is high up, because no change in this absorption has been detected in the highest balloon flights. Such an ozone-containing layer must get rid of the energy it absorbs from the sunlight, and it may well therefore be warmer than the nearly transparent layer of ordinary air below it.

At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

At 9½ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

The Heavens

At our usual hour of observation (as indicated below the map) the most conspicuous star is Arcturus, high up on the meridian. Almost directly under it, but much lower, is the planet Jupiter, which is still brighter. The bright stars, Antares, or Scorpio, and Spica, or Virgo, are about equally distant from Jupiter, to the left and the right, and the planet Saturn is to the right of the latter and a little higher up.

Leo and Gemini are the most prominent constellations in the west, the latter setting. The Great Bear is high in the north with the Little Bear and Dragon below, and Cassiopeia on the horizon. Cygnus, Lyra and Aquila form a fine group, low on the east, and Ophiuchus and Hercules are high above them.

The Planets

Mercury is an evening star, and is excellently placed for observation early in the month, being more than twenty degrees from the Sun and about eight degrees north of it. During the first ten days of May he sets at about 8:40 P. M. and should be very easy to see, appearing brighter than Aldebaran, which is a few degrees above and to the left. He then moves rapidly between us and the Sun, and is in conjunction with the latter on the 20th.

Venus is a morning star in Pisces and Aries, rising at 3:35 A. M. on the 15th, and is still very bright.

Mars is slowly drawing nearer to the Sun, but is still visible as an evening star, setting about 9:00 P. M. in the middle of the month.

Jupiter comes into opposition on the 5th, and is the brightest object in the evening sky. His satellites afford a fascinating spectacle with even a small telescope. Attention may be called to the evenings of the 23d and 30th, when the first and third satellites go behind the planet, and the second in front of it. From 9:20 to 10:22 P. M. on the 23d, all three of them are thus hidden at once. The fourth satellite is also in line with the planet and behind it, but its orbit is tilted so that it escapes being hidden, though it will take careful looking to see it with a small telescope, just south of the planet.

Saturn, which was in opposition in April, is about 25 degrees west of Jupiter, and 10 degrees higher in the sky. This too presents a fine telescopic sight, with rings wider open to our gaze than they have been for four years. Uranus is in Aquarius and is still a morning star, rising at 2:00 A. M. in the middle of the month. Neptune is in Cancer and is in quadrature east of the Sun on the 6th, becoming an evening star.

The Moon is in her last quarter at 1:00 P. M. on the 7th, new at 6:00 P. M. on the 15th, in her first quarter at 9:00 A. M. on the 23d, and full at midnight on the 29th. She is nearest us on the 28th, and farthest away on the 13th. During the month she is in conjunction with Uranus on the 10th, Venus on the 12th, Mercury on the 17th, Mars later on the same day, Neptune on the 22d, Saturn on the 26th and Jupiter on the 28th.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

The Acid Test for Tractors

FOLLOWING the mandate of a recently enacted law, the State College of Engineering in Nebraska has devised a set of testing apparatus hitherto unknown in that industry. A great many tractors have been sold in the State in the past few years, and not all of them have come up to representations. Thereupon the legislature passed a law providing that before any make of tractor can be sold in the State a stock model shall be tested and passed upon by a board of three university engineers.

This is the only State where such a law exists and where such tests are made. This put upon the engineering staff the task of improvising testing apparatus that would uncover any defects in construction and give a reliable guide to the power capacity and fuel consumption of each tractor as well as information with respect to endurance.

The object of the law is not only to protect the purchaser but to encourage the manufacture and sale of improved types and thus add to the scope and success of their use. Pending the result of tests temporary permits are granted. The tests are in no sense competitive, and companies are forbidden to use the results of the tests in any manner that would cause the reader of their advertisements to understand that the university recommended the use of any given type or model in preference to others. If the result of the official test is published at all, the entire report must be included.

The complete tests consist of eight parts, as follows: Drawbar work at from one-third load to full load for 12 hours, which gives the tractor an opportunity to be limbered up and is the only part of the testing that is allowed to be done by tractor company representatives. Brake-horsepower test at rated load and rated speed for two hours—to show whether it will carry its rated load on the belt and also to show fuel consumption for rated load. Brake-horsepower test at load varying from maximum to no load with all engine adjustments for one hour—to show speed control on varying load and fuel consumption. Brake-horsepower test at maximum load for one hour with carburetor adjusted to give maximum power—intended to show maximum horsepower on the belt. Brake-horsepower test at half-load for an hour with carburetor adjusted for most economical operation at half-load—to show fuel consumption at half-load. Drawbar-horsepower test at rated load for 10 hours, on half mile cinder track—to show if it will carry rated drawbar load continuously, and also fuel consumption on drawbar work. Series of short runs with an increase of load for each run until the engine is overloaded or drive wheels slip excessively—to show maximum drawbar-horsepower. Miscellaneous tests to include work on inclines, turning radius, effectiveness of brakes or any feature demanding special investigation.

The fuel and oil costs are paid by manufacturers. If the manufacturer says his tractor will operate only on gasoline, it is tested on the lowest grades of gasoline sold in the State; and if on gasoline and kerosene, the test is by the less volatile kerosene. The manufacturers also specify the kinds and grades of lubricants.

The testing machinery consists, in the main, of three devices, one for fuel weighing, one for obtaining belt horsepower and one for drawbar tests. The two latter call for the use of the dynamometer. For belt tests an electric dynamometer of 150 horsepower capacity, is used. This is driven through an extension shaft mounted on ball bearings and carrying a paper pulley 10 inches in diameter and 12-inch face. The tractor is belted to this pulley. The generator can be adjusted to offer any horsepower resistance. While this test is being made the tractor fuel-tank is disconnected and connection made with the special fuel-weighing tank.

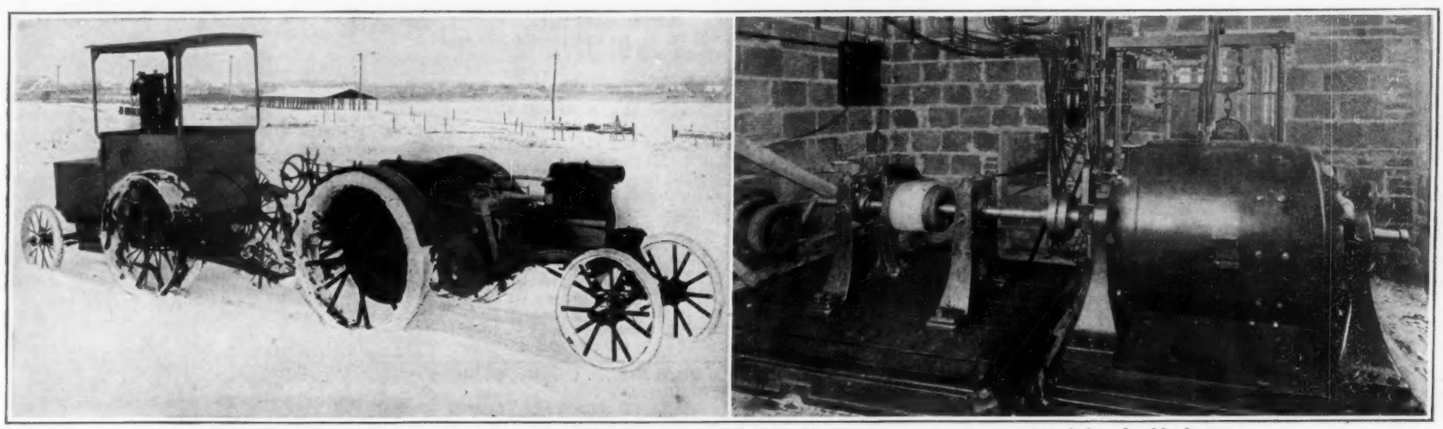
The drawbar tests are made on a cinder track that has several short grades, none of them over 3½ per cent. The track is kept in as nearly the same condition as possible, through dragging, rolling and sprinkling when necessary. To provide a drawbar load that can be kept constant during a test and which can be adjusted to different sizes of tractors, a dynamometer car or loading machine is used. This loading machine consists of a tractor chassis with an electric generator mounted in place of the engine and driven by power from the drive wheels of the machine as it is pulled by the tractor under test.

The loading machine has a capacity up to about 30 drawbar-horsepower. For the larger tractors additional loads will be pulled behind it. The drawbar pull is registered by a traction dynamometer, attached between car and tractor. For brake tests the fuel tank is put on a scale and set at the same height as the tank on the tractor.

In the second test the governor is set to run the engine at the rated speed, and if it does not come up to rated speed at rated load, the test is made to determine the greatest load at that speed. The third test is made without any engine stop or change of adjustments on tractor. The same conditions govern the fourth test, and if the speed should change during the test enough to indicate that conditions had not become constant when the test started, it is repeated with the necessary change in load.

In the sixth test the load applied is the rated load and the speed is that obtained with the gears set as recommended for plowing. If this proves to be an overload it is reduced until the engine speed is up to rating and the slippage on the grounds deemed not excessive.

In the endurance test it is not deemed possible to determine the efficient life of the tractor. If an undue amount of wear is suspected in any part it is taken to pieces for inspection. The test makes it possible to detect any features that will give trouble. Observation is also made of all replacements, repairs, adjustments and cleaning; also any difficulty in the operation of lubrication, cooling or any other part of the machine.



Left: **The dynamometer car used for the drawbar tests.** *Right:* **Stationary dynamometer employed for the block tests**

French Are Testing Producer Gas Trucks

THE shortage and consequent high price of gasoline and similar fuels in Europe has created considerable interest in substitute fuels. Producer gas is being experimented with and it is stated that marked progress is being made in England with trucks using producer gas engine. First prize in the French gas-producer trials has been won by the British entrant, the Thornycroft suction gas vehicle. The six competing trucks used four-cylinder engines designed to run on gasoline. Four of the trucks employed charcoal as fuel; the other two, a mixture of one-fifth charcoal and four-fifths wood.

The competition showed that with an engine designed for gasoline there was a loss of power when gas was substituted. Taking the power of the gasoline engine as 1, with producer gas the power would drop to between 0.50 and 0.73 if the engine were not altered in any way, and to between 0.70 and 0.90 if changes were made in the compression, size of valves or areas of valve-openings and gas passages. It has been considered that the results of the trials show that there is an economy of 25 per cent in the use of gas compared with gasoline.

The Thornycroft power plant differs essentially from others on the market in one or two features. The steam is produced in a separate generator, which is not attached to the producer, by heat from the engine exhaust on the principle that the heat of the exhaust gases must necessarily be proportionate to the power developed, and thus the amount of steam can be made proportionate to the working. This generator can be detached from the engine and entirely taken to pieces for cleaning, which is a point of very great importance. The Thornycroft power plant is intended primarily for use with the chassis of the British War Office pattern, known as the J type, and is designed as an integral part of the machine. Consequently, every part is easily accessible, in no way interfering with the fitting of an ordinary cab or body and detracting but little from the appearance of the vehicle. Moreover, the weight can be cut down to a minimum.

Generally speaking, the engine can be started on gas in less than 10 minutes from cold, after which it is said that the car can be left standing for an indefinite period, the engine idling, with a certainty of starting away as soon as the throttle is opened, whatever the load. No water is used for the cleaning or scrubbing of the gases, and cleaning is thereby much simplified, while the possibility of any corrosion or electrolytic action taking place is eliminated.

During the war, it will be recalled, motor vehicles were operated with illuminating gas as fuel. Good results were obtained, but not sufficiently good to replace gasoline, even at present high prices.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

SHOE.—E. MAGALDI, c/o Barzano & Zanardo, Naples, Italy. The invention relates to a shoe having a sole formed of a pad of soft material enclosed in a covering of fabric, a semirigid sole, and an insole composed of impermeable fabric. A purpose is to attain a good ventilation of the lower part of the shoe, to condense the vapors given off by the foot, to preserve the parts constituting the bottom of the shoe and to make its outside and inside impermeable.

LIMB ATTACHMENT.—J. E. GANTENBEIN, Box 457, Kelso, Wash. This invention relates to an attachment for use in connection with high shoes. An important object is to provide an attachment for the forelimb which overlaps the shoe tops and thereby prevents foreign matter, such as dirt and snow, from entering the shoe top, in addition, the attachment is a means for bracing the limb and keeping the same warm in cold weather. The device is secured by eyelets and laces and is neat in appearance. (See Fig. 1.)

CONVERTIBLE GARMENT.—I. WHEELER, 14 E. 32d St., c/o Royal Novelty Mfg. Co., New York, N. Y. This invention has for its object to provide a convertible garment more especially designed for wear by children, and arranged to be worn either as a combined waist and bloomers or as a dress and bloomers. A further object is to provide a garment which will be exceedingly neat in appearance when worn in either of its two forms, and to permit of convenient opening for sanitary purposes.

SUPPORTER.—D. GOTTLIEB and L. B. SIEGEL, 1744 Lexington Ave., New York, N. Y. The invention relates to supports for soft collars. Among the objects of the invention is to provide a support by means of which the body of the collar will at all times hold its normal, i. e., straight position so that a neat appearance will be presented, and to provide means for engaging the body of a tie to hold the tie in its proper position with respect to the collar.

DISPATCH JACKET.—W. E. MOORE, 25 Van Cortlandt Ave., Staten Island, N. Y. An object of the invention resides in the provision of a garment in which a large amount of bells, coin and other valuables can be carried comfortably under an ordinary coat or overcoat without being evident, and in which the disposition of the articles is such as to make it difficult for them to be stolen, the wearer of the jacket having both hands free for self-defense.

Electrical Devices

AUTOMATIC REEL FOR ELECTRIC DEVICES.—R. B. BOYLE, 4262 Jefferson St., Kansas City, Mo. An object of the invention is to provide a device adapted to be attached to a telephone instrument or the like, to receive a portion of a flexible electrical conducting member connecting the instrument with a fixed connection, whereby the telephone may be positioned at varying distances, and when the distance is decreased the slack is taken up by the action of a spring.

FUSE PLUG.—W. F. and J. HEINS, c/o W. F. Heins, 24 Barrow St., Albany, N. Y. Among the objects of the invention is the provision of a fuse plug which may be readily taken apart, cleaned, and replaced without the use of tools. A further object is to provide a fuse plug wherein the contact resiliently grips the fuse while being easily removable. The device is formed in such a manner as to cause the burnt gases to slowly ooze out should the fuse "blow."

REMOTE CONTROL FOR INDICATORS.—O. E. GROSHELL, 1808 W. Diamond St., Philadelphia, Pa. The foremost object of the invention is to provide electrical switch mechanism to be operatively associated with any type of indicator, such mechanism comprising an electro-magnet, a normally raised locking pawl, a latch disk with an armature capable of attraction by the electro-magnet, and connecting means between the disk and pawl, to lower the pawl when the disk is rocked.

CORD ADJUSTER.—N. L. PRUDEN, Box 44, Florham Park, N. J. The invention relates more particularly to an adjuster in the form of a shell and spring pressed plungers for holding electric lamp cords or other electric fixtures, and object is to provide an adjuster which may be connected to a cord at any point, and which will permit any desired adjustment to take up slack. A further object is to provide an adjuster which can be manufactured and sold at a reasonably low price. (See Fig. 2.)

TELEGRAPH RELAY—C. J. ROGERS, 914 S. Vresa St., San Antonio, Texas. One of the foremost objects of the invention is to provide a relay, employing differentially wound transmitting coils which are particularly adapted for use on "leaky" lines. Another object is to provide a relay employing differentially wound transmitting magnets or in other words, magnets on the cores of which there are separate windings of different cubical content of wire of the same gage, the use of such magnets resulting in a very prompt armature action.

REMAGNETIZING APPARATUS—J. C. BENNER, Box 252, Webb City, Mo. Among the objects of the invention is to provide an apparatus having poles adapted to directly engage the poles of the magnet to be changed and of such construction as to be capable of this direct arrangement without removing the magnets operated upon from the structure with which they are associated, the device being especially adapted to directly engage the poles of the magnets of a Ford magneto and to effectively remagnetize these permanent magnets.

ELECTRIC MOTOR—C. Z. COLEMAN, 698 Bush St., San Francisco, Cal. The principal object of the invention is to provide an electric motor that will develop a maximum of power although confined in a comparatively small space. It is customary in a motor to arrange the armature coils so that they rotate between the respective north and south pole pieces of the field, this inventor arranges the armature coils in front of the magnet or magnets. In this manner a longer lever arm is provided for the armature resulting in a greater power being obtained. (See Fig. 3.)

Of Interest to Farmers

DEPTH GAGE FOR DISK HARROWS.—S. H. PHELPS, c/o Blount Plow Works, Evansville, Ind. This invention relates to a depth gage for disk harrows having a hub to be fitted on an axle between the harrow disks, and having a broad area to ride on the surface of the ground, one end of the hub having a greater diameter than the other, the larger end having a concave bearing surface to contact with the convex side of a harrow disk.

SPRING GATE AND WIPER FOR SEED WHEELS.—B. N. RODDA, c/o Collison & Co., Torrensville, South Australia, Australia. This invention has for its object to improve the grain feed of a seed drill and cause a positive delivery of the seed or grain from a supply hopper through a smaller and automatically adjustable outlet to the grain funnel or tube, and in particular to insure the sowing of the grain more evenly. A further object is to provide an outlet which shall be capable of automatic adjustment.

BACKBAND HOOK—E. W. BAILEY, Lawley, Ala. The invention relates to hooks for the backband of draft animals, the principal object being to provide a hook which will serve to firmly support the trace chain and prevent the same from slipping in either direction. A further object is to provide a hook so constructed that a trace chain may be readily attached thereto, and a hook which will be simple and practical in construction, strong and durable in use, and inexpensive to manufacture (See Fig. 4.)

GRAIN TRANSFERRING DEVICE FOR SEPARATORS—B. B. STAUFFER, 1323 Broadway, Kansas City, Mo. An object of the invention is to provide a mechanical means for transferring grain or straw from a loaded wagon or stack to a desired place. A further object is to provide a device having a grain carrying fork arranged for movement in a horizontal plane, whereby the fork may be moved the length of the stack and adjusted automatically as the height of the stack is decreased. A further object is to provide a device for use with a grain separator of the ordinary type.

Of General Interest

TRAP.—S. B. CONNER, Toppenish, Wash. The invention relates to animal traps, particularly to that form which is normally concealed in leaves. The principal object is to provide a trap in which the leaves or rubbish are automatically thrown from between the jaws as the trap is sprung. A further object is to provide an ejector device which is operatively connected to the jaw actuating means so that the jaws and ejector are operated simultaneously.

APPARATUS FOR FASTENING STEEL PAIL TOPS.—S. M. JOHNSON, Middlefield, Ohio. Among the objects of the invention is to provide an apparatus for fastening steel pail tops, including a base plate on which crimping jaws are mounted, and embodying means for holding the plate up so that the crimping edges of the jaws will come no lower than the edges of the lugs which are to be crimped under. The device can be set upon a pail and all the lugs of the lid crimped under in one operation.

GUN SIGHT.—H. H. JONES, 417½ So. Main St., Los Angeles, Cal. An important object of the invention is to provide a gun sight having means whereby the same may be adjusted transversely of the barrel so as to compensate for wind. A further object is to provide a sight with means whereby the same may be adjusted vertically so that the gun may be inclined in accordance with the range.

MASSAGE DEVICE.—J. O. LINDEN, Box 491, Albuquerque, N. M. Among the objects of this invention is to provide a massage device in the form of a watertight container, and to provide means for facilitating the filling of the same, and locking means for holding the cover in position. The device is of elliptical shape and provides a pair of massage surfaces, one being perfectly smooth, the other transversely ribbed or corrugated.

MOVABLE DAM.—H. E. FRYE, 723 Second St., Marietta, Ohio. An important object of the invention is to provide a dam which may be raised or lowered during any stage of water by means which are entirely under the control of a single operator. A further aim is to provide a dam whereby the entire width of the river may be navigated, and which provides means for directing the flow of water so as to protect the banks from strong currents of water. The device may be easily exposed for repair by workmen in small boats.

POISON CONTAINER.—S. S. SNYDER and G. W. SHORT, White Sulphur Springs, Mont. The invention relates to the construction of a poison container in which the poison is readily accessible to rats, mice or other small animals or rodents, and which is so formed as to be inaccessible to fowl and birds because the latter find their food by sight. A further object is to provide a container which can be readily secured to the ground and moved from one location to another.

DRINKING CUP.—H. SCHNACKENBERG, Box 101, Stroudsburg, Pa. The general object of this invention is to provide a drinking cup made from wax paper, the bottom being formed by overlapped tongues integral with the cup and bent into position to form a closure at the bottom, a flange at one side is adapted to overlap the opposite edge when the blank is bent to form a round body.

METHOD OF CLEANING TUNNELS, SUBWAYS, OR THE LIKE.—W. I. SMITH and A. R. BURNETTE, c/o W. I. Smith, 44 Fourth Ave., Brooklyn, N. Y. The invention relates to a method of cleaning tunnels, subways or the like of refuse, papers, dust or other extraneous matter by means of air. A further object contemplates a method which effects the washing, filtering and purifying of the air, and the redistribution of the purified air.

WEATHER STRIP.—F. C. GORDON, High Orchard, Westfield, N. J. The object of the invention is to provide a simple and durable flexible metal plate that may be

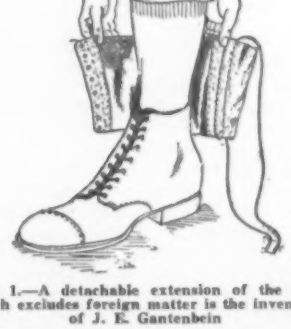


Fig. 1.—A detachable extension of the shoe which excludes foreign matter is the invention of J. E. Gantenbein

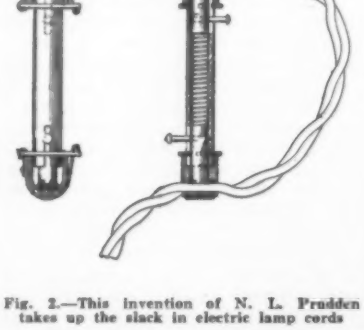


Fig. 2.—This invention of N. L. Prudden takes up the slack in electric lamp cords

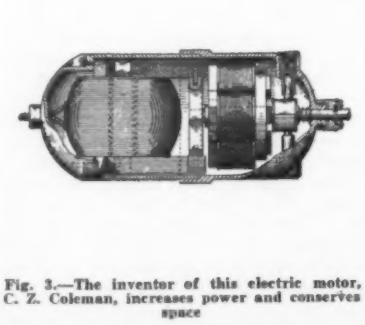


Fig. 3.—The inventor of this electric motor, C. Z. Coleman, increases power and conserves space

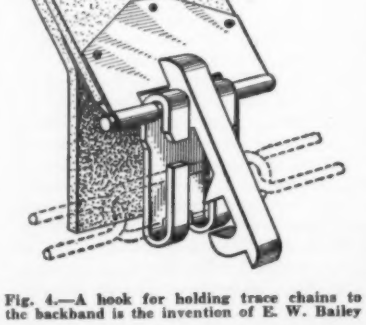


Fig. 4.—A hook for holding trace chains to the backband is the invention of E. W. Bailey

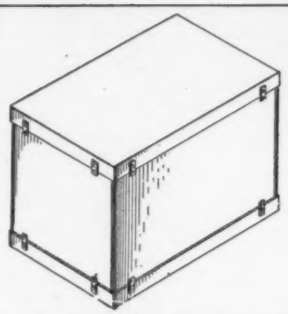


Fig. 5.—D. F. Ebbert is the inventor of this metal shipping case designed to protect its contents

Fig. 6.—A baby carriage whose self-contained parts permit it to be carried like a suitcase. Invented by F. Paschoal

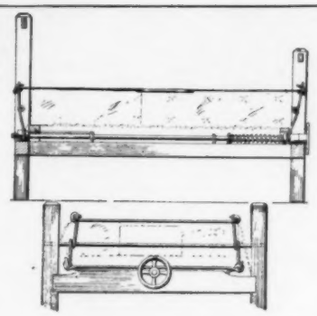


Fig. 7.—This ingenious mechanical invalid bed is the invention of W. W. Zachary

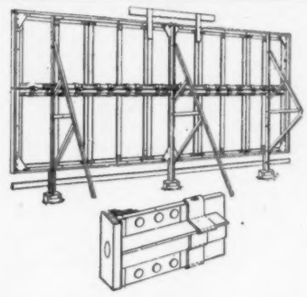


Fig. 8.—A knock-down signboard invented by S. J. B. Whited permits quick removal and re-assembly

easily fitted on doors or windows during the construction of a building, or may be readily mounted after construction to make the windows practically airtight when closed, but permit them to open freely. The strip is not prominent, and presents a good appearance.

SHIPPING CASE.—D. F. EBBERT, Main and 4th Sts., Wheeling, W. Va. The primary object of the invention is to provide a metal shipping case which is designed for shipping dry goods and piece goods of various kinds. A further object is to provide a metal case which will be comparatively light, will effectively protect the goods from fire and water, as well as from chafing in transit, will not be as bulky as a wooden case and will be useful not only in shipping, but in storing the goods. (See Fig. 5.)

PRICE MARKER.—G. W. GILMAN, c/o Parker Pen Co., Janesville, Wis. This invention relates to a price marker especially adapted for use in connection with pencils, fountain pens and the like. Among the objects is to provide a price marker on which the marking element is so constructed that it depends upon the construction of the article with which it is used for its operation, and which may be removed from time to time and used with various articles of a similar nature.

RING.—A. A. O. SEELER, 622 Varsity Road, South Orange, N. J. An object of the invention is to provide a ring which will fit fingers of various sizes. A further object is to provide an adjusting means which may be used for regulating the internal diameter of a ring, which will be simple and practical in construction and will not affect the appearance of the ring.

UMBRELLA PARASOL.—I. H. WEINBERG and C. F. BISBING, 23 E. 21st St., New York, N. Y. Among the objects of the invention is to provide a construction whereby the cover connected to the ferrule of an umbrella or parasol is caused to move longitudinally of the rod by the action of a spring or elastic member to compel the central upper portion of the cover to assume a canopy shape when the cover is opened.

ROPE STRUCTURE.—H. V. WHITLOCK, Box 58, Bergen P. O., Jersey City, N. J. The invention relates to cordage and more particularly to a strand structure for ropes comprising a plurality of strands laid together in twisted relation to form the finished rope, each of the strands comprising a cord of fibers laid parallel in substantially untwisted relation and a covering of spun yarns, these yarns being spirally laid about the core and in contact with one another throughout their length.

CORNICE SCAFFOLD.—F. ORTHMANN, 1300 Gates Ave., Brooklyn, N. Y. The object of this invention is to provide a cornice scaffold capable of being disassembled so that it may be stored in a minimum of space. A further object is the provision of a scaffold which may be readily handled by a relatively unskilled person, and will provide a structure insuring the safety of the person while effecting repairs.

SIDEWALK DOOR.—B. SCHACHT, 279 East 148th St., New York, N. Y. One of the principal objects of the invention is to provide a door equipped with a guard which will effectively protect the public when the door is in open position. Another object is to provide a door which includes means for detachably associating the door with its frame to permit of its removal for the purpose of repairs or the like.

COMPASS.—H. GOLDBLATT, 3924 West 16th St., Chicago, Ill. Among the objects of the invention is to provide a compass by means of which the direction in which a person is facing may be actually indicated by the needle itself, thereby eliminating any necessity for calculating such as is necessary with the ordinary compass. The compass may be used in the ordinary manner to indicate the north by means of the needle.

BABY CARRIAGE OR COLLAPSIBLE CART.—F. PASCHOAL, 218 Central Ave., New Rochelle, N. Y. This invention has for an object the provision of a carriage in which the various parts can be collapsed within the body portion, so that in collapsed condition it is entirely closed up and substantially simulates a suitcase and can be carried as one. A further object resides in the simplicity and ruggedness of the parts, which may be made ready for use with a minimum amount of effort. See Fig. 6.)

AUXILIARY BED.—C. KORP, Box 442, Okmulgee, Okla. An object of this invention is to provide an auxiliary bed which may be folded up and slidably disposed beneath an ordinary type of bed by means of track members, free from the floor, while not in use. A further object is to provide a device that is durable and simple in operation.

STOP PLATE FOR SLICERS.—J. A. CHOW, Quarters 8, Fort Sheridan, Ill. The invention has for its object to provide a vertical stop plate for a cutting board, which is adapted to have a vegetable held thereagainst so that a piece, ordinarily too small to cut, may be held by the fingers against the stop plate, and with a knife in the free hand cut the piece into as many thin slices as desired.

INVALID BED.—W. W. ZACHARY, 1921 W. 10th Ave., Pine Bluff, Ark. An important object of the invention is to provide a bed having means whereby the patient may be temporarily raised to permit the entire mattress, or a section, to be withdrawn and changed in its position, or replaced by another mattress without inconvenience or discomfort to the patient. A further object is to provide a bed whereby the adjustments may be made by one person without going from one end of the bed to the other. (See Fig. 7.)

BOTTLE STOPPER.—J. P. MCLAURIN, c/o McLaurin & Thompson, Dillon, S. C. Among the objects of the invention is to provide a cap for bottles which extends over the outlet for the purpose of protecting the bottle, whereby when the liquid is discharged it will not come in contact with dust or dirt. A further object is to provide a cap which may be used in conjunction with any kind of a bottle closure, and does not interfere with the free application or removal of the closure.

CORD HOLDER AND CUTTER.—M. E. GEROULD, 39 Howell St., Rochester, N. Y. This invention relates to supports for balls of twine. An object is to provide a twine carrier having means whereby the same may be conveniently applied to one's clothing, so as to be within convenient reach when it is desired to wrap a bundle or the like. A further object is to provide a simple means for folding the free end of the twine and severing the same.

WINDOW SCAFFOLD.—F. ORTHMANN, 1300 Gates Ave., Brooklyn, N. Y. The invention aims to provide a scaffold which may readily be applied to and removed from a window by an unskilled operator without marring the woodwork of the window frame, and which will provide an absolute rigid support. The device may be associated with different portions of the frame with equal facility, and when not in use may be stored within a minimum amount of space.

THREAD-GUIDE GRIPPER.—E. S. HALL and A. N. KAZNAKOFF, c/o Miss Ella D. Hall, 150 W. 92d St., New York, N. Y. Among the objects of this invention is to provide a simple, efficient, durable and economically manufactured device in the form of a metal cap and spring, which can be attached to any type of thread spool whereby thread may be easily held to prevent the unravelling of the thread from the spool.

WINDOW GUARD.—S. KAUFMAN, c/o Butler Printing Co., 239 W. 35th St., New York, N. Y. This invention has for its object to provide an arrangement for show windows wherein means are provided for covering automatically and quickly the goods displayed in the window, in case the same is broken and thereby protecting the goods against theft. The breaking of the window automatically sets in operation the mechanism connected with the covering device.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. The present invention relates more particularly to metallic spring means for securing powder compacts in vanity cases, and at the same time provides for the removal of the securing means, for the purpose of replacing or renewing of the powder compact.

ABRADING COMPOUND.—C. F. STEPHENSON, 146 E. South St., Fostoria, Ohio. Among the objects of the invention is to provide a grinding compound which will possess all the abrading qualities to successfully act on relatively soft metal, such as Babbitt metal, but will not injure the working parts of machinery which are of steel or the like. The compound comprises abrading powder 50 pounds, Venetian red 3 pounds, table salt 2 pounds, powdered bluing ½ pound.

FLY SWATTER—C. D. YOUNGER, Edgeley, N. D. An object of the invention is to provide a simple means for detachably mounting the flexible striker sheet on the handle to permit the substitution of a new sheet when an old one is worn, while retaining the handle and other parts. Another object is to incorporate in the structure an inexpensive handle of lighter weight, preferably formed of a single length of wire suitably bent.

WINDOW VENTILATOR—J. C. SHUTTLEWORTH, 763 McDonough St., Brooklyn, N. Y. The invention has for an object to provide a construction which may be bodily applied and removed and may be arranged at the top or bottom of any window within certain limits. Another object is to provide a ventilator having sliding end members for adapting the ventilator to windows of different sizes, and having spaced protecting screens, forming chambers for receiving a disinfectant in addition to providing for the passage of air.

SIGNBOARD—S. J. B. WHITED, c/o Shreveport Blowpipe and Sheet Iron Works, Shreveport, La. This invention relates more particularly to the structure of a knock-down sign or bill board, and has for its object the provision of a structure of this character which may be very compactly stored and easily assembled and erected. The device is durable and strong, the framework being of metal firmly bolted together, with surface of galvanized sheeting. (See Fig. 8.)

POWDER PUFF—E. G. GILES, c/o Oxford Down Mfg. Co., 127 Walnut St., Lockport, N. Y. An object of the invention is to provide a powder puff which comprises a receptacle for powder and which is provided with draw strings having applicator puffs at the ends of the draw strings so that the puffs can be enclosed within the receptacle when the latter is closed. A further object is to provide a powder puff which is ornamental in appearance.

PRESS CLOTH—W. A. LEE, Box 240, Augusta Ga. The invention relates to what are commonly known as press cloths, that is cloths used for wrapping oleaginous seeds and other oil bearing material while the latter are pressed in hydraulic presses, the press cloth acting as a filter through which the oil may be discharged and will retain the meal or cake within the cloth. The invention aims to provide a device which will not only increase the yield of oil but reduce the amount of meal which passes the usual cloth.

Hardware and Tools

VALVE LIFTER.—R. I. SHIBIYA, 5371 N. 27th Ave., Omaha, Neb. This invention has for its object the provision of a simple, strong and compact tool whereby valve springs may be lifted and held in an elevated position while the stems of the valves are being removed, together with the valves, for purposes of repair. Another object is the provision of means whereby after the tool has been operated to lift the valve the handles can be left in place and are locked in their operative position and released when the work is finished.

APPARATUS FOR APPLYING GROMMETS.—R. E. MALOY, 25 W. 15th St., New York, N. Y. An object of this invention is to provide a device in which the initial cutting away of the material is eliminated and in which means are provided for initially puncturing the material and gradually enlarging the puncture by rolling the edge of the material defining the opening to produce a bead and at the same time rolling the grommet body over the bead to insure the proper gripping of the material.

WRENCH.—A. W. MINNEY, 5265 McKinley Ave., Stockton, Calif. Among the objects of the invention is to provide a pipe wrench which is simple in construction, easy to manipulate, compact and exceedingly strong. A further object is to shape the jaws to grip a pipe upon the initial movement of the wrench, and to adapt the wrench to operate upon pipes of different diameters, and without lacerating or marring the pipe to any appreciable extent.

KEY PULLER.—L. E. STEPHENS, Box H, Fellows, Cal. The invention relates to key pullers adapted for removing keys from shafts. The object is to provide a key puller having means whereby the grip on the key is tightened as the key is being withdrawn so that the device will not slip when in use. The device is particularly useful in pulling keys of various sizes or removing broken or headless keys.

NUT LOCK.—B. G. PATTERSON, c/o Patterson Lock Nut Mfg. Co., 916 Wrigley Bldg., Chicago, Ill. More particularly the invention relates to a nut of that type in which the nut itself is provided with internal means to lockingly engage the threads of a bolt, and aims to provide a simple means for holding a locking dog in the nut slot against accidental displacement while the nut is being screwed onto the bolt.

WRENCH.—M. N. ERICKSON, Box 147, Columbia Falls, Mont. The invention relates more particularly to ratchet wrenches of the kind employing a brace. The object is to provide a wrench having a brace of novel formation so as to especially adapt the same for use in connection with the nuts of the fourth connecting rod of a Ford car, or the like, although it is obvious that the device may be used in inaccessible places.

CORNER BRACKET AND FASTENER FOR SCREEN FRAMES AND THE LIKE.—R. J. BURHEN, Kirkwood, Mo. The object of the invention is to provide a simple device by means of which the corners of screen frames may be rigidly connected and

in such manner as to obviate the necessity of a skilled mechanic in the assembling operation. A further object is to provide a brace and connecting member which is formed from a single piece of sheet metal with parallel side plates.

NUT-HOLDING MEMBER.—L. F. CRUMLEY, R. No. 3, La Follette, Tenn. The invention relates generally to nut holders for use in connection with the band adjusting and manipulating rods located within a transmission case of an automobile which bands require replacement from time to time, at points where the lack of space render the usual nut removing operation difficult and frequently resulting in the dropping of the nuts into the transmission case. The object is to provide an implement by which the nuts may be securely held and withdrawn when free of the rod.

WRENCH.—R. BUKER, Castle Rock, Wash. An object of this invention is to provide a wrench which is designed to grip nuts or other objects by applying pressure on a lever after the jaws have been adjusted with a thumb-screw to loosely fit the object to be gripped. The position of the jaws does not determine the position of the lever. The lever makes it possible to maintain a tight grip on the object with a relatively light pressure. (See Fig. 9.)

THREAD-GUARD CASTER.—H. C. MILLER, 11 Floral Ave., Binghamton, N. Y. The general object of the invention is to provide a caster with a scraper for use on trucks in textile mills, factories and like places, whereby not only will threads be effectively prevented from winding in the wheels, but the wheels and axles may have lateral tilting movement relatively to the truck or rack to conform to uneven floors.

HACK SAW.—F. M. SMITH, Bridgewater, S. D. The general object of the invention is to provide a hack saw so formed and arranged as to be available for sawing in places under conditions affording only the most limited clearance for the movement of the saw. A more specific object is to provide a hack saw reflecting practical considerations looking to the facility with which the parts may be assembled and adjusted.

HANGER.—C. A. MEUNIER, Middleneck Road, Great Neck, N. Y. Among the objects of the invention is to provide a gutter hanger which may be constructed of copper or other suitable material, and will incorporate sufficient rigidity to withstand any strains to which it is subjected without having its body distorted. A further object is to provide a hanger which will serve to support the gutter in such a manner as to preclude any danger of the latter becoming detached from the body of the former.

DOUBLE SEAMING TOOL.—F. B. WENDEL, 465 Hawthorne Ave., Newark, N. J. The invention relates to the manufacture of cans and refers to a seaming tool for associating the can heads with the body of the can. The object is to provide a tool which is adapted to be associated with a punch press by means of which the tops and bottoms of the cans may be directly pressed and secured to the can body in a single continuous stroke of the punch press.

HOSE-CLAMPING TOOL.—F. W. GUNN, 318 Columbus Ave., Boston, Mass. This inventor has been granted patents on two tools of a similar nature. The inventions relate to tools for manipulating and applying bands or wires, and while having other fields of usefulness, are well adapted and designed for applying clamping bands or wires to hose or like flexible tubes for clamping and securing the same to pipes, nozzles, couplings and the like. The principal object is to provide a simple and easily operated tool that is adapted to first draw up a metallic clamping band or wire tightly around a hose, then bending a proper length of the wire back to make the coupling secure, and then severing the extremities that are caught in the device after an operative movement thereof. (See Fig. 10.)

COMBINED CASING AND TOOL SPEAR.—M. W. JONES and B. H. BRUSH, c/o Jones-Everett Machine Company, Ardmore, Okla. This invention relates to spears used in the drilling of wells, the purpose being to provide a spear which is operable to simultaneously effect the withdrawal of both the well casing and drilling tool or underreamer from the well, and to thereby eliminate the necessity of withdrawing the drill line through each and every joint of the casing as is necessary with spears as usually constructed.

BED FRAME CONSTRUCTION.—M. HERING, 472A, Route 2, White Plains, N. Y. The object of the invention is to provide means whereby the rails and posts of beds can be easily, positively, firmly and pivotally connected together. Another object is the provision of means whereby if the bed frame is to be moved out of a room through a narrow opening such as a door, it can be easily collapsed without taking the posts and rails apart.

RAKE.—R. E. LEAS, Suvern, Minn. The inventor has been granted two patents of a similar nature; they are primarily intended for use on lawns, although not limited to this particular adaptation. In connection with rakes of this type considerable difficulty is experienced, incident to the fact that leaves, dead grass, etc., quickly clog the teeth of the rake, the inventions aim to provide rakes in which the teeth may be easily cleaned in semi-automatic manner, and without necessitating the operator using his fingers, also overcoming the delay experienced in the usual accomplishment of this result.

RAZOR-BLADE POCKET KNIFE—A. A. TUBBS, Hotel Carlton, 68 Plummer Ave., Hammond, Ind. Among the objects is to provide a device in which a cutting blade may be detachably sheathed within a combined handle and sheath when not in use, and extended at will to permit the use thereof as a knife. A further object is to provide a simple device in which safety razor blades, that would otherwise be discarded, may be utilized.

Heating and Lighting

REVERSIBLE COVER FOR COOKERS.—T. KELLY, 3527 Peralta St., Oakland, Cal. The particular object of the invention is to provide a cover or lid for a cooking vessel formed in such a manner that it can serve several functions. If secured on the vessel in the ordinary way it serves as a lid while when it is reversed it constitutes a second cooking vessel which may be used for such foods as jams which do not require excessive heat, while the main vessel may be simultaneously used for cooking foods which require more heat. (See Fig. 11.)

HOPPER FOR HEATING PIPES—C. D. MCCALL, c/o Atlanta Blow Pipe & Heating Co., Atlanta, Ga. An object of this invention is to provide a hopper in the nature of a catch-all with an outlet door to be applied to heating and ventilating pipes in such a manner as to catch such dust or other matter as may fall into the pipe through the floor grating. A further object is to provide a hopper which can be readily attached to existing pipes without the necessity of taking the pipes down.

Machines and Mechanical Devices

COMPENSATING APPARATUS FOR WELL DRILLING OUTFITS.—O. E. OAKES, Baxter Springs, Kan. A specific object of the invention is to provide a frame with reciprocally mounted spring-held pulleys to which a wire line is applied and which is so employed in connection with the drilling outfit that the springs are made to take up shocks and unusual strains in the drill cable to prevent breakage thereof. (See Fig. 12.)

WINDMILL GEARING.—J. F. STRUBLE, 421 W. "B" St., Hutchinson, Kan. An object of this invention is to provide means for converting a rotary into a reciprocatory motion, and to provide a windmill gearing having means whereby the pump rod is caused to reciprocate with a uniform and steady movement thereby eliminating the possibility of serious breakage of the parts and excessive wear.

PRINTING PRESS.—A. HEINER, 447 E. 80th St., New York, N. Y. The invention aims to provide a printing press which may be either manually operated or power driven, and which permits of its being manufactured and maintained in operation at a minimum of cost. Among the objects is to construct a device of this character which although embodying extremely simple construction will include an inking, printing, feeding and cutting mechanism, so that the entire operation of printing may be performed by the one machine.

ADAPTER FOR ACETYLENE TANKS.—B. WESTERVELT, 331 Bainbridge St., Brooklyn, N. Y. The invention relates to an adapter for acetylene tanks, and comprises a tubular shank, an integral head formed at one extremity, an enlarged elbow at its opposite extremity, said elbow and head having central bores communicating with the bore of the tubular shank, and a retaining sleeve including a pair of semi-cylindrical mating sleeve sections and means for retaining the sections in mated relation on the shank to permit of rotary and sliding movement.

TYPESETTING MACHINE.—W. H. HANLON, Martinez, Calif. The invention relates to a machine to set and distribute printing type which is operable by keys in a manner simulating the typewriter thus accomplishing the result of moving the type rapidly and entirely mechanically both in the setting and distributing thereof and practically as rapidly as a typewriting machine is operated.

FLOW BARREL.—W. G. RICKETTS, address George H. Myers, Box 2022, Tulsa, Okla. This invention relates to flow barrels especially adapted for use in oil wells. The flow barrel is intended for use only in wells that produce considerable gas with the oil and is provided with means whereby to relieve the gas pockets in the oil column. It may be placed anywhere in the tubing of the well so long as it is above the working barrel and beneath the level of the oil.

TYPEWRITER.—J. T. FIELD, 339 West Clark St., Pocatello, Idaho. An object of the invention is to provide an improved means and method of suspending the type-bars, whereby primarily, a medium will be provided permitting an individual, as well as an aggregate adjustment for these members, permitting wear to be compensated for. A further object is to provide means which will serve to reduce the complication incident to a "double bank" machine.

COTTON UNLOADER AND CLEANER.—J. L. Hart, c/o Hart Cotton Machine Co., Chickasha, Okla. The invention has for its object to provide mechanism adapted to be arranged in the gin house or the like, for unloading the cotton and passing it to a place of storage, and a plurality of cleaning mechanisms is provided, and so arranged that the cotton may pass from the gin house to the place of storage without cleaning, or may be subjected to a single or double cleansing operation with but a single handling.

AUTOMATIC FILLER.—D. E. A. SAVOY, Newcastle, N. B., Canada. This invention relates to an apparatus for measuring liquid as it is dispensed from a container and for automatically shutting off the flow of the liquid after a predetermined amount has been dispensed. An object is to provide an apparatus which may be conveniently attached to various forms of liquid containers, and which will be simple and practical in construction.

PLASTIC PACKING MATERIAL FOR STUFFING BOXES.—D. STERNLIEB (Deceased). Address Paget Moeller & Hardy, Rienergasse 6, Vienna, Austria. The object of the invention is to provide a plastic packing which will keep perfectly tight even under severe conditions of use for a long time. The composition consists of metal sponge, as distinguished from solid metal grains, fatty substances preferably oils, flaky graphite and pulverulent filling substance such as chalk.

FEEDING ATTACHMENT FOR PRINTING PRESSES.—J. BIVER and J. S. KOSCH, c/o J. Biver, 1201 Peach St., Alameda, Cal. Among the objects of the invention is to provide a feeding attachment for a printing press which can adapt itself to a wide range of different sized objects and which can be easily adjusted to feed folded envelopes of any size as well as letterheads or other single sheet units of paper.

TRAMPER.—W. H. HOLTBY, 2155 E. Pierce St., Mangum, Okla. The invention relates to trampers for packing or baling cotton or the like. An important object is to provide mechanical means for feeding the cotton and raking the same into the central portion of the press box, such means operating in conjunction with the tramper head, so that the feeding automatically stops upon the descent of the tramper head.

ICE CREAM CUTTING MACHINE.—V. GUARDINO, 3014 Ocean Ave., Sheepshead Bay, Brooklyn, N. Y. Among the objects of the invention is to provide a device in which the feeding mechanism will form a part of the machine. A further object is to provide a cutting element which will have a stripping mechanism associated with it, whereby any tendency of the material being cut, clinging to the knife will be avoided, the device also provides for the cleansing of the feeding mechanism after each operation.

CALENDAR WATCH.—K. K. BUBO, c/o Geneva Watch Company, 127 North Dearborn St., Chicago, Ill. The object of the invention is to provide a watch for indicating the day of the week and the day of the month in addition to the time of day. A further object is to provide a device which may be inserted in an ordinary type of watch after the watch is manufactured, and in which the several indicating hands may be set, one independent of the other.

ROTARY PUMP OR MOTOR.—R. N. TRANE, c/o The Trane Company, La Crosse, Wis. An object of the invention is to provide a rotary pump which, unlike most of the pumps of the type, has instead of a line contact, surface contact of relatively considerable area, thereby obviating the disadvantages which arise when the contacting

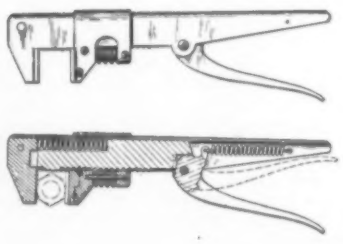


Fig. 9.—This practical wrench, the invention of R. Buker, prevents rounding of the nut

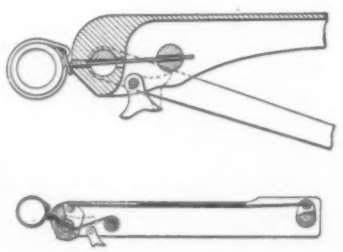


Fig. 10.—This invention, made by F. W. Gunn enables hose-clamp to be neatly and tightly applied

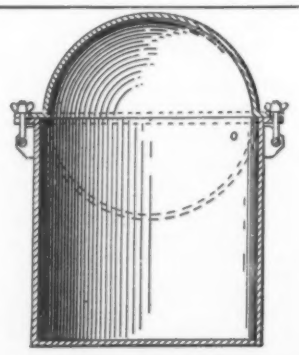


Fig. 11.—A combined lid and second cooking vessel is the invention of T. Kelly

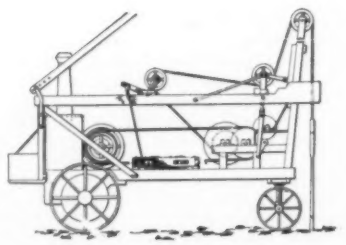


Fig. 12.—To absorb jerks in well-drilling cables O. E. Oakes has invented an ingenious device

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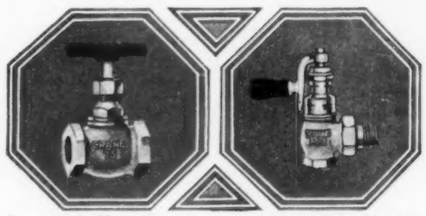

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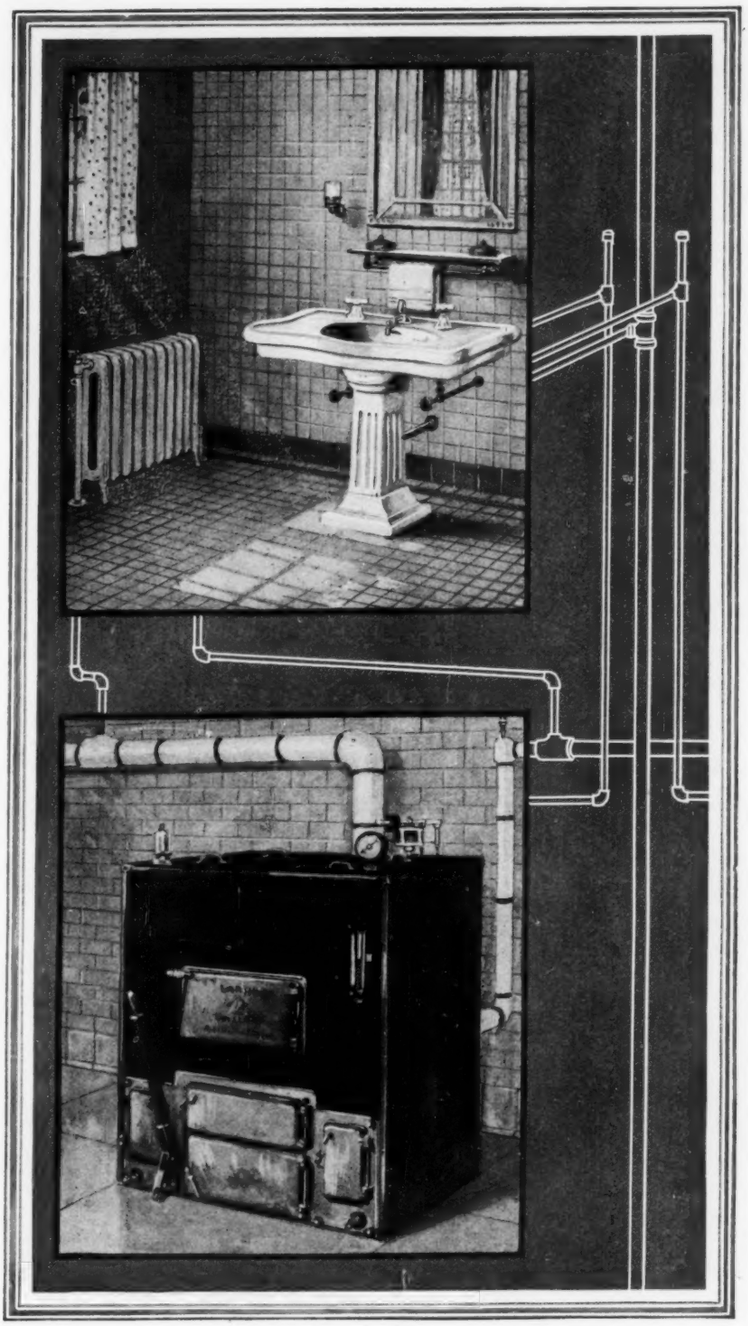

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There would be tax collectors to take your share of national, state and municipal taxes, amounting to over forty million dollars. There would be men and women coming for a fair return on their money invested in telephone stocks and bonds—money which has made the service possible. Then there are the people who produce the raw materials, the supplies and manufactured articles required for telephone service.

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Science Notes

Blueberries an Inch Thick.—A blueberry an inch in diameter is not a dream but a possibility. At the United States Department of Agriculture testing plantation at Whitesbog, four miles east from Brown Mills, New Jersey, about 25,000 blueberry hybrids have now been fruited. Many of them have produced berries three-fourths of an inch in diameter, several four-fifths of an inch, and one of them this year reached almost seven-eighths of an inch.

Pictures on Apples. — The following was recently cabled over to *The New York Herald*, and published without our being able to verify it. Pictures or photographs printed delicately on apples are the latest discovery of a French pomologist. Taking a negative, and carrying out a process whose secret he has guarded, this nurseryman is able to reproduce the picture upon the smooth skin of the apple, where it remains till the fruit is entirely decomposed.

Should Scientists Give Their Discoveries to the World?—The first subcommittee of the League of Nations' intellectual cooperation commission recently held a session. Professor Henri Louis Bergson of the University of Paris and the French Academy presided. The discussion centered particularly on the extension of rights of scientists so that they may be able to share in the eventual benefits derived from the application of their discoveries. The example of the late Professor Roentgen should always be held up before any gathering of scientists.

Snow Insurance.—In England you can insure against almost anything if you can pay the premium, and it is getting about as bad here. Who would expect anyone would want to insure against the loss occasioned by the failure to snow? Up in Lake Placid, however, snow seems to be necessary for winter games, and as a great many expenses had to be met, failure of a sufficient quantity of snow or a sudden thaw would have been disastrous. So the insurance broker was invoked to write a policy, which was done. The brokers wrote a policy providing for a minimum of a foot of snow for the two days that the ski jumping champions would need it.

Stage Animals May Be Abolished in France.—Trained animals have always been very popular with the French and there are two "winter" circuses in operation all the time in Paris. Recently French authorities have been making exhaustive inquiries as to how performing animals are trained. It is understood that those inquiries have shown that this training is almost torture. It is believed that efforts will be made to eliminate performing animals from all French films where they have a prominent place. The French Society for the Prevention of Cruelty to Animals has appealed to film makers not to employ animals in the future. The members of this society have agreed to leave any theater or motion picture house where performing animals are shown. It is doubtful if this will be effective. As we write there is a letter from a kindly lady in one of the evening papers who wants all the animals in the Central Park Zoo and in the New York Zoological Park returned to their native jungles. It is strange how many misguided persons are at large!

Cassina a Tea Substitute. — A new drink called "Cassina" may give tea a run. It is brewed after the manner of tea from the leaves of the cassina shrub which grows abundantly along the South Atlantic and Gulf States. Its active principle is caffein. Cassina contains less tannin than tea, however, and is less harmful to the system on this account. The average of all analyses of cassina made by the bureau showed a content of 1 per cent of caffein, and some samples ran as high as 1.65 per cent. The highest amount found in coffee is given as 1.80 per cent, and for tea the percentage runs as high as 3.50. About a year ago, Congress appropriated $5000 for the investigation of the possibilities of the cassina plant. The Bureau of Chemistry, using this money and a lot of old tea manufacturing machinery which had been used in the Government's long and futile attempts to grow tea at a reasonable cost in this country, set up an experimental station for the manufacture of cassina, near Charleston, S. C. The shrub grew wild in the vicinity, and the bureau's experiments hinged largely about the manufacture from its leaves of a product from which the caffein-containing drink could be brewed economically, and on a commercial scale.

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- ☐ Contractor and Builder
- ☐ Architectural Draftsman
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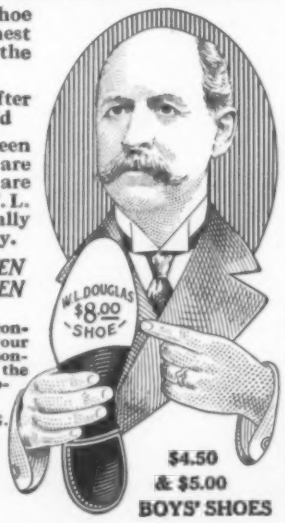

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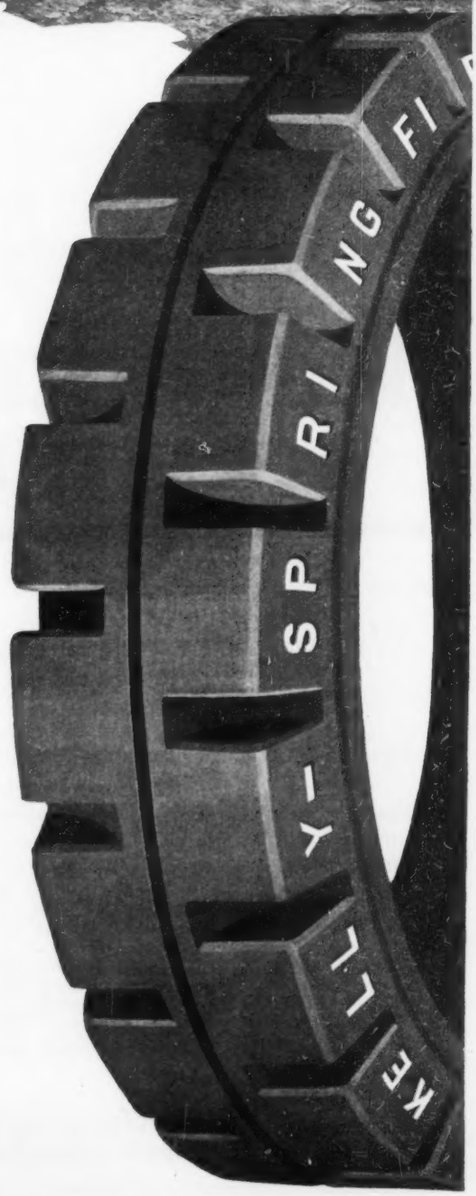

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Science Notes

Copernicus Honored.—The 450th anniversary of the birth of the great Polish astronomer was recently observed in practically all civilized countries, where there is any interest in astronomy. Copernicus certainly went far to make astronomy an exact science.

Esperanto Popular with Far Easteners.—It is perhaps not strange that Esperanto, the auxiliary language, is gaining headway in the Far East. This language is more acceptable to Orientals than the existing languages of Europe. It has made special gains in Japan.

Again the Metric System.—Like daylight saving the metric system is almost sure to bob up each year. There is little to report, except some progress towards the goal of the supporters of the movement has been made. It is slow work, however, notwithstanding the honest efforts of the good board of the Metric Association whose offices are at 156 Fifth Avenue, New York, where those interested can obtain full information.

The Eagle as a Nuisance.—Fox farmers report that eagles are a source of difficulty in the raising of blue foxes in Alaska, according to a representative of the Biological Survey, United States Department of Agriculture, recently returned from a trip of investigation into the fox-farming industry in the Territory. Those birds are reputed to prey extensively on both silver and blue foxes, particularly on the young pups.

Smallest Fish in World Inhabit Lake in Luzon.—Probably the smallest fish in the world are to be found in the mountain lake, Buhl, on the island of Luzon, Philippines. This fish, which the natives call the smarapan, is the most minute vertebrate animal known to science. It weighs only half a grain, and half an inch is its maximum length. This appeared in a daily paper and as the item was interesting, if true, we took the trouble to consult Dr. Lucas, director of the American Museum of Natural History, and he not only said the item was correct, but gave some additional information and compared the minute fish with a whale. He writes as follows: *Mistichthys luzonensis*—8 weighed 130 m. grams; 1 weighs 1.9866 grains; 3500 weigh one pound 7000 grains; 14,000,000 weigh one ton and 840,000,000 weigh 60 tons—Blue whale.

A Licensed Bank Vault Wrecking.—It is not often that a bank vault is entered except by the door, especially when the president is looking on, but this happened in Paterson, N. J., when a bank clerk was locked into the vault by an accident. The huge door moved noiselessly on its hinges, there was an ominous click as the time clocks snapped their tiny bolts and everything was safe for the morrow except the young clerk was caught. The agonized friend who had inadvertently allowed the door to close, called the officers of the institution who began frantically telephoning to contractors who had electric drills and burning torches and skilled mechanics. A force of forty men was soon assembled, and realizing the impossibility of attempting to wreck the door, attacked the vault from the top, and in relays, cut through the concrete until the steel plates were reached. Electric drills were put into action and through the first holes oxygen was forced, as the vault was not a very large one and the air must have soon become vitiated. The torches were then applied and after four hours' work a surgeon and the president descended through the jagged hole and the door was released from the dominion of the clocks. The limp form with the face of agony was borne to the ambulance whose engine had been throbbing for hours. The victim had a very narrow escape. He was unconscious, deaf and terribly bruised on the knuckles from fruitless attempts to escape. Hearing finally returned and it is believed that recovery will be permanent. This dramatic incident gives much food for reflection. Every bank vault should be inspected carefully by a high official, not a clerk, before locking and there should be an oxygen tank provided in the vault and every clerk should be instructed in its use. Whether the time locks should be arranged so that they can be operated from the inside without keys is a technical question involving vault security. The event shows that it takes four hours with forty men working in relays with all the electric equipment, oxygen, burning apparatus, etc., at their command to make an entry. The bank vault is still several jumps ahead of the burglar.

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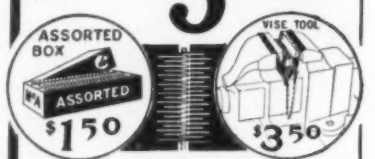

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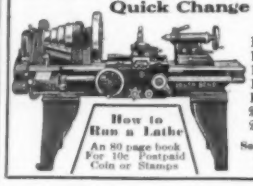

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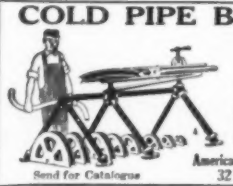

What it costs to bend pipe one way, per bend:

1-inch pipe	5 cts
2-inch pipe	10 cts
4-inch pipe	25 cts
6-inch pipe	60 cts
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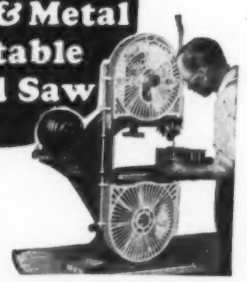

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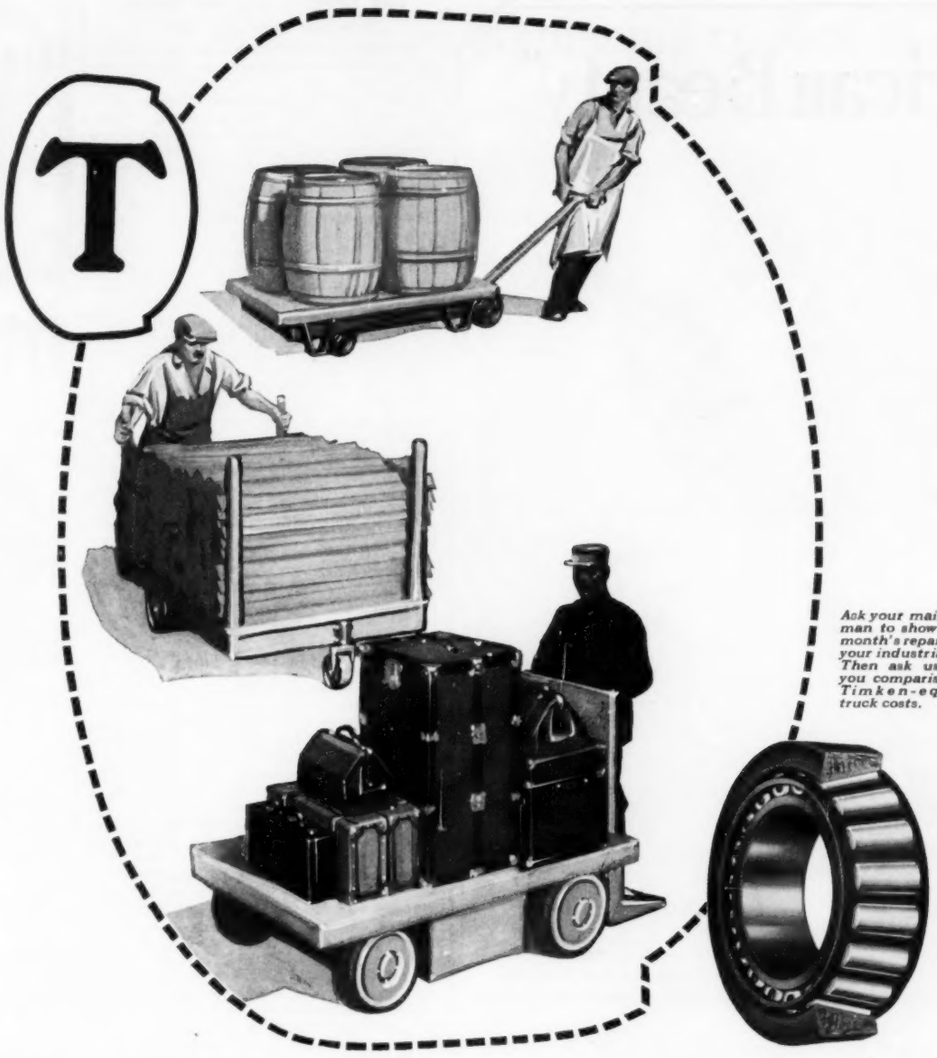

Ask your maintenance man to show you last month's repair bills on your industrial trucks. Then ask us to give you comparisons with Timken-equipped truck costs.

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The maintenance cost of an industrial truck is materially decreased if the wheels are equipped with Timken Tapered Roller Bearings.

Timken Bearings carry thrust loads, as well as radial loads. Consequently a truck piled high with heavy material can weave in and out through the factory, efficiently carrying the heavy thrust loads which develop from such conditions. Thus is power saved, wear minimized, and maintenance costs reduced.

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The Burglar and the Alarm

(*Continued from page* 295)

if the teller makes the least false move. What happens in such cases may be judged from the robbery, three or four years ago of a Brooklyn bank by the bandit, Hamby. The teller set off such an external alarm, whereupon the bandit promptly killed him and shot another bank officer. He used an ordinary taxicab to get to the bank and to make his escape.

The first improvement on this dangerous alarm was one of similar character, but with no gong on the bank front. Instead, a wire was connected with a buzzer in a nearby police station or store often in the adjoining building. By its means help could be summoned without letting the bandit hear any gong. In order somewhat to conceal the movements of the teller, the pushbutton was often placed in the floor where he might step on it. But it was soon apparent that this trick was well known to bandits and that false movements of the feet were as deadly as the use of the hands. So the inventor toiled once more and produced various types of bar or rod alarms. A typical form consists of a metal bar across the inside of the teller's counter. On being ordered to hold up his hands, the teller obeys and apparently makes no false moves, but actually he leans against the bar and sets off the alarm. But bandits also know this device and they will, as criminals always do, keep well abreast of all similar inventions likely to be evolved.

The best and safest alarms of this type leave the teller's cage unequipped with any device. But back in the banking rooms, out of the sight of the bandit, are buttons and bars, which unseen employes may press in time of peril. These do not expose their users to death, but they send in an alarm of which the bandit remains in ignorance, perhaps until he had been surrounded.

So much for the banks. A more interesting development of the anti-burglar alarm has to do with the commercial houses and is especially important in the great cities, where its use, in one form or another, has become general.

The commercial alarm falls into two general classes, called local and central office systems. The former is always some adaptation of the old gong alarm, often plus a roundsman or watchman. Various kinds of mechanisms, affixed to the doors and windows of lofts and shops, are connected electrically with gongs on the outside of buildings. To supplement these there is usually the patrolman, whose duty it is to cover a certain number of blocks in a given district and rush to the point of attack in case any gong goes off.

In the great central district of New York City, bounded by Fourth and Eighth Avenues and Twenty-third and Thirty-fourth Streets, perhaps the richest half square mile of mercantile territory in the world, with its enormous tall loft buildings crammed with the most precious silks and furs, many hundreds of such alarms and of the more complicated kind have been installed to foil the silk and fur burglars, who are said to carry off about five million dollars worth of these precious stuffs every year.

Burglars beat some of these alarms by many devices. If the gong is situated no higher than the second story of the building, the marauders watch till both the special patrolman and the officer on the beat are out of sight. Then they run up light collapsible ladders and muffle the gong before making the break. Some makes of gong alarms are, however, so housed that this is impossible. Where the gong is situated just outside a front window of some high loft which they intend to rob, one of their number hides in the street and waits till the patrolman has passed and is round the corner and some blocks distant on his march. Then the outside man gives the signal. The burglars crack the lock in a second or two, rush through the loft, open the window, break or muffle the alarm, close the window and go to work. (This, according to the special detectives of the New York police department.) The watchman, who has heard the gong sound briefly, comes running, but before he can reach the street the alarm has been silenced, the window is closed and all seems serene. There may be ten or twenty gongs affixed to the very building in which the robbers are at work. In any event, there are other gongs across the street and all down the block. How is the patrolman to know which one was tampered with? The best he can do is to summon aid and begin a slow and cautious search. The armed burglars have all the advantage, and in most

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IRON in raw materials is the arch enemy of many products. In glass sand or cullet it means discolored glass. In brass scrap and borings it means imperfect castings. In china or pottery slip it means inferior pottery. In dairy food it means death of animals. In abrasives it lowers cutting properties. In hundreds of other processes the removal of iron is essential.

It is nearly always hidden in quantities of materials, so the old method of hand picking is giving place to the positive method of searching out the hidden iron by means of high intensity electro-magnets. Powerful magnetic pulleys and specialized machines, built for definite requirements and separations, see what eyes could never see and accomplish what thousands of hands could never accomplish.

Tramp iron such as bolts, tools and chips is removed from conveyed material that is fed to crushers or pulverizers. This eliminates the possibility of damage to grinding machinery and in mills and elevators it stops sparks—the frequent cause of disastrous dust explosions.

Every superintendent or executive who wants to cut costs in sorting, refining, reclaiming, and separating minerals and materials cannot afford to overlook Dings Magnetic Separators. The many uses are described in separate bulletins. Write

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Dings High Intensity MAGNETIC SEPARATION

cases get away with their loot. This may be hidden somewhere in the building and removed the next day, when other boxes, bundles, bales and parcels are flowing out of the place in the ordinary course of business.

It must be remarked here that there has been much progress in the manufacture of these external or local alarm systems within recent years and that some of them are highly regarded by the experts who pass upon such devices for the insurance companies. Many thousands of them are now in use in all parts of the country and all of the better makes are much more difficult to tamper with than some parts of my article may have indicated. The better types now have the gong enclosed in a housing which makes it impossible or, at least, difficult for the burglar to do any muffling or tampering. The premises so protected are provided with unsuspected traps and switches which set the alarm ringing if disturbed, even though the burglar may have succeeded in entering a place in spite of the alarm.

But in the greater cities today the other type of burglar alarm and protective installation has come into favor—that is, the so-called "central office system." With this device there are no gongs on the buildings, and no patrolmen. Instead, the premises of the banker or other business man are connected with conveniently located offices of the alarm company by underground electric wires. Armed officers wait at these central offices for alarms and rush to the scene in motor cars.

The premises protected by this system are wired, completely or in part, with hidden electric strands forming a network under the floors, above the ceilings, under the plaster of the side and end walls of the protected room or rooms, and with screens over all openings, such as doors and windows. During the day, the alarm is disconnected but as soon as the place is closed, the system is in operation and, theoretically, at least, it becomes impossible to enter by any means without alarming the central office and summoning the armed guards. The system is so arranged that if a protected shop or bank is improperly closed or locked the central office is aware of the fact and enabled to send out its men to secure the premises correctly.

At the switchboard the maintenance of a fine electrical balance on each installation is insured by terminating each circuit on a galvanometer, whose needle assumes a neutral position when the protective installation is properly "set," but from which it deviates to sound an alarm whenever the circuit resistance is varied. Additional safeguards in the nature of visual "drops," lamp signals and buzzers prevent the fluctuations of the needle remaining unnoticed. A "station set" at the subscriber's premises provides an instrument for sending and receiving signals and for cutting out the protection on doors and movable windows during the open period.

The most generally known protective element on the subscriber's premises is the long familiar "screen" for door and window protection, in which the circuit is carried back and forth as fine wire embedded in the slats. Another form commonly seen from the street is the protective border of metal foil ribbon on glass panels in doors and transoms and on show windows. One of our illustrations shows the method of protecting walls and partitions by fine wire embedded in parallel wooden strips.

The insurance rates in New York City may be taken as a fair rod by which to measure the efficacy of these various alarm systems. At least they reflect the opinion of the concerns which pay the losses when one or the other kind of alarm is beaten by burglars. The old gong and patrolman system gets a 10 per cent discount from the normal insurance rate charged where there is no protective device. Partial protection by the central office system gets a discount of 25 per cent and complete protection by the latter method is allowed a discount of 50 per cent. Accordingly, the insurance companies rate the complete central office system five times as effective as the old gong and patrolman arrangement.

But there is a strange contradiction in the figures on losses where these installations have been employed. One of the largest insurance companies made tabulations of its 1921 losses and found that for every $56,000 paid out in cases where there was no alarm system whatever, $43,000 was paid to firms using gong and patrolman systems and $42,000 to those employing the central alarm system. It may be that figures such as these

Replacing coolies in Japan and supplying shovel labor in Canada

Barber-Greene Loaders working in Tokyo (above) and in Canada (below)

How the rising cost of unskilled labor enforces machine shoveling

With the generally increased industrial activity, unskilled labor is getting scarcer and the rates for it generally higher.

There is little likelihood of material change in this condition; immigration is limited and it has long been a common statement that "we are absolutely dependent on alien labor to use the shovel."

The situation is enforcing and hastening the broader use of Barber-Greene Bucket Loaders (mechanical shovelers).

Their economy and efficiency is so pronounced that even in Japan, where labor is cheap, they show a decided profit.

In the remoter regions of Canada, where labor for road-building is not easy to get and keep, they are used to keep down the size of construction crews.

Here in America, where they were first made and used, their use has become general among contractors and industrial plants.

They are used for shoveling crushed stone, sand, gravel, coal and similar materials.

We have hundreds of recorded cases showing the cost of using these machines as against less efficient mechanical equipment and shovel labor.

Send for additional data

We will be glad to submit typical cases, together with specifications, drawings and photographs of the equipment.

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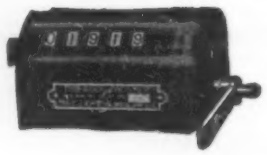

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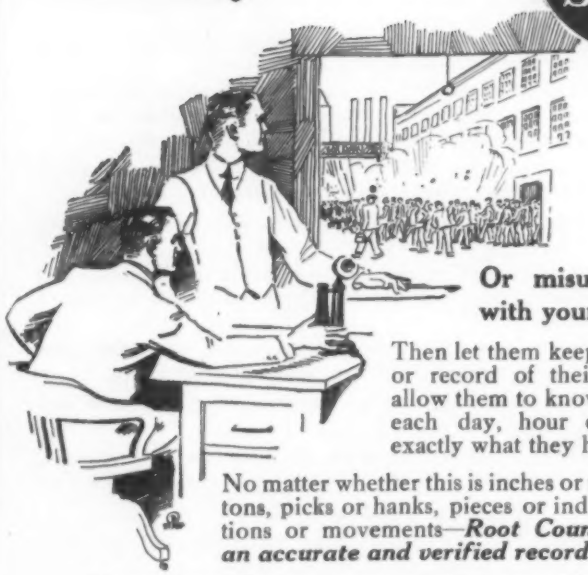

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will disclose decided changes in risk if continued over a period of years, but on their face they show the old gong system to have been nearly as effective in practice as the most costly and complicated mechanisms.

The point seems to be that the burglars have probably not been able to beat the central office system in a mechanical sense, but in practice they have played loosely with it. They cannot, or so I believe at present, tamper with the finely balanced system of electric wires, but they can circumvent it. This is one of the oldest of criminal tricks and the one that most often surprises inventors and officers. What the thief cannot penetrate he can get around. But how?

A few weeks ago a firm which had installed the most costly form of protection was robbed of $75,000 worth of furs. The burglars began by getting a young man or woman confederate employed by the firm for a short time. This accomplice made a study of the premises and discovered that at one point the ceiling over the factory was made of heavy concrete and that this had been considered so formidable a barrier that no wiring was needed at this point. The burglars waited until the following Saturday evening, when they broke into the loft above the one they planned to rob. This place had no burglar protection, being used only as a storehouse for ordinary merchandise. Between Saturday night and Monday morning, the burglars picked, hacked and bored their way through that thick layer of solid concrete, opened a hole two feet square and descended into the loft of the furriers, where they selected the choicest and most salable pelts and carried them off through the room above.

Even more remarkable was a robbery of somewhat older date. Here it was the factory of a large silk garment manufacturer in a big room on the eleventh floor of a great 20-story loft building. He had his place completely protected, or so he believed. The floors, walls and ceilings were all wired, the doors covered with intricate lattices and all the windows similarly protected, save one. This was a small affair opening from a washroom into the wide court or areaway of the building. This court was 40 feet across. There was not another window within 25 feet of the single unprotected entrance.

A young girl studied this loft for the burglars, found the little window and reported. In the course of the next few nights the burglars made their preparations. When all was ready, one of their number was let down from the roof on a ladder of light rope. Swinging 150 feet above certain death on the concrete pavement, on a frail ladder, 140 feet long, he reached the little window, opened it with a jimmy and entered, making fast the ladder so that his confederates might follow. The men on the roof came down this risky support to the loft, whence they carried a hundred thousand dollars worth of fine silks to the roof; bolt by bolt, trip after trip, up that swaying ladder, dangling frightfully over the chasm, where a crushing death lurked in the concrete pavement beneath. And they got clean away with their loot.

Fine rope ladders, electric alarms and 20-story buildings were still in the dream state when the gay Ned Caisley put the British jeweler and his ingenuities to defeat, but was this old burglar not the father of these modern rascals and was not the battle quite the same then as now—an unremitting struggle between the genius of maker and breaker, inventor and thief?

Tutenkhamon's Tomb

(*Continued from page 296*)

was originally named, was evidently likewise but a youth. Rings and pendants bearing his throne name Nebkheprure, found at Tell el-Amarna, show that at first he maintained his capital there. But the rebound of inherited beliefs, repressed but not conquered by Ikhnaton's fervor, was too strong. Amon, the god of Thebes, now won honor even in his rival's home, for some of these same trinkets add to the royal name the epithet "emanation of Amon." Likewise a limestone memorial tablet now in Berlin shows Tutenkh*aton* worshiping *Amon* and his consort Mut.

The other previously known relics of Tutenkhamon, bearing usually this revised form of his name, come mostly from Thebes itself and prove that this city had soon regained its leadership. Yet even here the king had at first ventured to enlarge his father-in-law's temple to Aton; and the only date from his reign is one in his sixth year on a piece of linen from the tomb at Thebes

(*Continued on page 351*)

Why?

THE Hawaiian language has no word meaning "weather." Why? Having no contrasts in temperature—nothing but perfect June weather all the year 'round—there's never any need to discuss the topic, nor even to think of it.

In this land of ours, no building is entirely fit for use until the word "weather" can be forgotten indoors. *Powers Automatic Temperature Control* will maintain the desired temperature with such unconscious perfection that this ideal condition will be happily realized.

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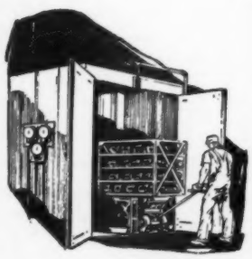

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In but a few years *every* industry, *every* manufacturer, will be using electric heat as a matter of course. Why do you wait?

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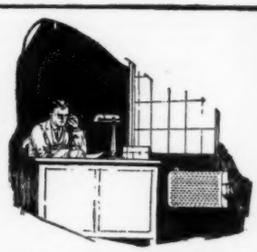

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Mechanical Engineering Notes

Machine Tools in Japan.—Of the $15,000,000 annual sales of machine tools in Japan, two-thirds is imported, chiefly from the United States, which furnished about 80 per cent. Great Britain gets practically the whole of the remaining business.

An Aged Belt Without Whiskers.—Recently a large 40-inch double leather belt was removed from service after 34 years of operation in an industrial plant on a water wheel drive that operates 24 hours a day. Although the machine which it drove for these years was worn out, the belt was cut up and was still giving service on other machines. During this time there was no record of the belt having given any serious trouble.

Hydraulic Bulging.—In the manufacture of many sheet-metal parts, operations such as bending, forming and expanding can be performed economically by hydraulic bulging. The work is placed in a die and water under a pressure of 600 to 1200 pounds is admitted directly into the work itself. One advantage of this method of bulging is the rapidity with which the water under pressure forms the article to the desired shape.

The Air-Steam Engine is Again the Subject of Experiments, according to *The Practical Engineer*, which states that the attraction to investigators is to be found in the fact that a mixture of compressed air and steam gives considerably more power than that produced by the same weight of air and steam used separately. Compressed air and steam are passed continuously into a mixing chamber, and on to the engine at unchanged pressures. A gain of about 25 per cent in indicated horsepower was made in one experiment.

Oil-Fired Boilers.—According to *Lubrication*, combustion in an oil-fired boiler should be completed in the furnace before the burning gases strike the tubes or boiler shell. If the flames strike the brickwork or tubes, overheating and blistering may occur. The high boiler efficiencies obtainable with fuel oil are due to a minimum amount of excess air passed through the boiler, to lower stack temperature, to smokeless combustion, to better heat transfer from furnace gases to boiler because of higher temperature, and to cleaner heating surfaces.

Anti-Galling Treatment for Pipe Couplings.—A contributor to the *American Machinist* states that when the threaded joint of oil-well pipe is made up with steel against steel, there is a tendency for the mate metals to seize and gall than with wrought iron or steel. This action is due to highly localized pressure, which cannot be avoided in a die-cut thread. An anti-galling treatment has been worked out for steel couplings used in the oil country. The principle is to place a very thin gasket of some non-ferrous metal between the threads, which is most readily carried out in practice by electroplating the coupling threads with soft zinc.

Helical Gears.—The teeth of spur gears make contact over their entire length, and the load is first thrown on the end of the tooth, producing a sudden and severe strain on the metal. Under such conditions the transmission of power through the gears is practically a series of impacts. Helical gears were developed to overcome this defect. The form of tooth employed is the involute, or a close approximation of it. In well-made helical gears there is a greater amount of rolling action on the teeth than with ordinary spur gears of the same face, and the load is put on and removed slowly, so that shocks and severe strains are avoided. The chances of breakage are thus reduced, and operation is more quiet.

A New Type of Boiler in which the water-tubes have a diameter of 12 inches and are rotated by means of a small electric motor, is the invention of a Swedish engineer, as described in *Power*. Rotation at 330 r.p.m. throws the water to the outside of the tubes, thus greatly increasing the heating surface in comparison with the amount of water used. The rotors are carried on bearings outside of the brickwork. The flue gases, after passing the battery of rotors, heat the super-heaters, then the high-pressure water economizers, next the low-pressure water economizers, and then pass into the stack at 350 to 400 degrees Fahrenheit. This corresponds to a boiler efficiency of 80 per cent. Extremely high pressures, up to 1500 pounds, are used, the shell of the rotors being three-fourths inch thick.

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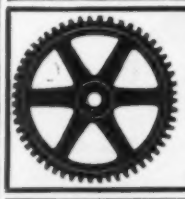

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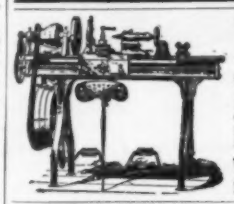

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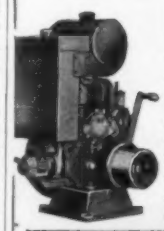

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Tutenkhamon's Tomb

(*Continued from page 348*)

where Ikhnaton's mummy had once rested. A large tablet found in the Karnak temple of Amon tells in Tutenkhamon's own words about his change of heart: ". . . . When his majesty was crowned as king, the temples of the gods and goddesses were [desolat]ed from Elephantine as far as the marshes of the Delta . . . His majesty . . . took counsel with his own heart, . . . searching for profitable things for his father Amon, . . . giving to him more than was done before." (Breasted's translation.) Two granite statues from the same temple, now likewise in the Cairo Museum, show the refined and delicate features of a sensitive youth. All three of these objects, as well as a statue-group representing Amon with his female counterpart Amunet, had afterwards been pre-empted by the later king Harmhab. The latter has perhaps attained more than his share of glory through other borrowings still unproved. Thus a famous statue of the god Khonsu, the third in the Theban triad as offspring of Amon and Mut, has been shown by Legrain to parallel closely in its features the above-mentioned statues of Tutenkhamon. Moreover, the style of the Khonsu statue is so like that of a renowned group of Mut and Amon which bears Harmhab's name on its base that Maspero once suggested they might even be due to the same hand.

The Metropolitan Museum of Art in New York possesses a gold seal-ring of Tutenkhamon, presumably once worn by one of his officials; and the New York Historical Society has a blue fayence ring to which his name gave value either as a symbol of royal favor or as an amulet.

Now in a flash comes a host of new material which may fill out to an undreamed of extent the picture not only of this transitional age, but of the extraordinary revolution that preceded it.

Biban el-Muluk, the valley of the kings' tombs, is a wild, desolate region amid the hills behind the western plain of Thebes. There, in chambers terminating series of corridors tunneled into the native rock of the hillsides, were once buried the pharaohs of the Empire, beginning just before 1500 B. C. Some 60 tombs in the valley were already known when the Earl of Carnarvon began his search for any that might still lie concealed. On November 5, 1922, Mr. Carter, after years of fruitless effort, came upon a step cut in the rock under the path leading to the tomb of Ramses VI. As soon as Lord Carnarvon arrived from England in response to a hasty summons, the steps and passages of the L-shaped approach were cleared. Plundering was suggested already at this stage by the presence of holes just large enough for a man to crawl through penetrating the blocked and sealed doorways. But these openings had been closed and resealed; and careful examination of all the seals has proved that even the resealing took place within ten years or so of Tutenkhamon's burial. His tomb had, then, alone so far as we yet know, escaped the more destructive attacks of the XX. Dynasty robbers who were brought to trial under Ramses IX. Its location had apparently been forgotten during the two centuries before the death of Ramses VI (about 1150 B. C.). The rubbish from the latter's new tomb above poured down and deeply covered the approach to the old one; and the workmen of Ramses VI even built their huts upon the sheltering débris.

The ante-chamber which the discoverers first entered is the source of practically all the treasures which were removed this year. The early plunderers had taken only objects or parts of solid metal, leaving the abundance of gold overlay. High couches, elaborate chairs and stools, dismantled chariots, boxes of royal clothing, cases of mummied meats, torch-holders (the oldest ever found), alabaster vases of complicated and hitherto unknown design, and even the funeral bouquets remained almost intact. The garments were badly decayed, but it was possible to obtain a complete record of their elegant ornamentation by photographing each layer before removal from its casket. A child's linen glove and a charming wooden bust have added new problems. Some have called the bust a dummy, a sort of glorified clothes rack portraying the king; but it seems to others, including the writer, much more likely to represent his queen, Enkhosnamon. A chair of state is notable for its inlaid decorations, which have in one place retained the old name Tutenkhaton. Most exquisite, surely, is a little vaulted chest painted with hunting and battle scenes so

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A crowded annex beyond the ante-room, reached by a blocked doorway near the left end of the far wall, has not yet been disturbed, but only looked into through the robbers' unclosed breach. In the right end wall of the ante-chamber, however, was a doorway fully walled up, repaired as the outer barriers had been, guarded at each side by a splendid statue of the king. This doorway, opened on February 16 after the ante-room had been cleared, revealed the hoped-for sepulcher. But the burial was unexpectedly elaborate and complex. An immense wooden shrine covered with gold and inlaid with blue fayence almost fills the chamber. Within is a second shrine, on whose bronze doors the original seals are still unbroken. It is, then, reasonable to assume that here for the first time an untouched royal Egyptian burial will be found. Over the second shrine hangs a canopy, it too adorned with gold. An ancient plan of the tomb of Ramses IV on a papyrus in Turin shows his red granite sarcophagus surrounded by wooden constructions which we can now see represent an outer shrine, a canopy supported by corner posts, and four inner shrines. Faced by the prospect of finding such additional shrines here also, the discoverers can but postpone the further investigation of the burial until next winter. It may then be possible to take down part of the chamber wall to facilitate examination and removal of the successive coverings that protect the pharaoh. Facing the portals of the shrines appeared the open doorway of another annex, called for distinction the "treasure house." The name suggests new marvels; but most of these, too, have not yet been removed. Among them is the box containing the so-called canopic jars wherein the viscera are separately preserved. It is protected by "four lovely goddesses in shining gold, standing in winsome grace with outspread arms and heads charmingly poised on one side. These exquisite girlish figures are fundamentally a new revelation of grace and beauty in ancient art. They are quite equal to anything ever produced in Greek sculpture and rival the greatest works of art of any age."

When we think of how much still lies within the tomb and realize that the comparatively few objects brought out this winter mean work for two years or more to come if they are to be properly conserved, recorded and evaluated, it will be seen how inadequate as a basis of detailed discussion are the hurried comments so far published. But full scientific accounts are promised. The capable staff of the Metropolitan Museum of Art is making the photographic record of the find, and Howard Carter himself is no mean artist. We may, then, reasonably look forward to a full complement of excellent photographs, on a par with those which have already been published, as well as plates in color that will reproduce the beauty, without the fragility, of these treasures.

The approach to the tomb has now again been filled with rubbish for protection until next winter's campaign. Meantime the crowded condition of the Cairo Museum has occasioned discussion as to whether a new museum should not be established at Luxor or the tomb itself be enlarged so as adequately to display its contents. Whatever disposition is made of Tutenkhamon's equipment, it will take its place in Egyptology as the outstanding embodiment of the world's first epoch of intellectual and artistic emancipation.

Extinct Races of Ape-Like Man

(*Continued from page* 303)

further back by a mile or two, but if so, he did not know it was retreating. Through such gradual transitions man had little trouble in establishing himself, by adaptation, to his environments.

Heidelberg man and Neanderthal man represent a branch of the tree which finally became extinct. Yet this branch of man lived during more than 200,000 years, leaving us many remains of his culture and fossils of himself. All we have of Heidelberg man is a single jawbone, which may be seen in the photograph to the left of the center. The narrow space between the sides of the jaw could hardly have given space enough for a mobile tongue. If Heidelberg man spoke, it must have been by means of grunts and other crude noises. This jawbone is very large, and is ample evidence, coupled with the fact that the stone implements found in the same stratum are so heavy that no modern man would find them easy tools to work with, that Heidelberg man was a great,

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There are reasons for believing that Neanderthal man, if not directly descended from the Heidelberg man of 200,000 years previous, did have his descent from a very similar being. Neanderthal man appears in Europe chiefly as a cave dweller. He is the original "cave man." The advancing ice, chilling the climate of Europe, drove him into the limestone caves of the hills. There he seems to have existed during the whole of the fourth or last glacial period, sallying out to hunt the reindeer and little wild horse for food, stripping the flesh from the bones, and bringing the larger bones to his retreat to be split open for the succulent marrow. Although he was a man, he was not like homo sapiens (which is us) in many ways. He was lower than any human race now living, although his brain, as measured by the capacity of his skull, was not greatly smaller than those of our living lower races. He was a great, chesty creature somewhat like a professional wrestler in this particular, with thick short neck, massive head and powerful arms. The articulation of his skeletons, of which many have been found, shows that he did not habitually hold his head upright, but rather that it was bent well forward, throwing his eyes on the ground. His forehead sloped quite sharply back, his brows stood out prominently, and his chin was entirely lacking, like that of an ape. But his nose appears to have been high, almost aquiline, unlike those of the more primitive modern races. He must have presented a truly forbidding appearance to the more advanced Crô-Magnon race which was destined to overwhelm and exterminate him. For the Cave Man came to an abrupt end some 25,000 years ago. He was an experiment that failed. A more intelligent race took his place.

Following back our diagram, we come to Eoanthropus. This is the name of the Piltdown man whose skull is shown in the photograph at the immediate left of the central bust. The Piltdown man was discovered in England in 1911, not in caves, but in gravels. Only a single specimen has been found, and the jaw of this specimen remains doubtful. It was found at a distance of three feet from the skull and may have been that of a chimpanzee. Therefore there has been much discussion over Eoanthropus. The skull itself is a very primitive sort with remarkably thick walls. Eoanthropus means "dawn man" and he is placed on the scale of intelligence where the ape has become a man, perhaps 125,000 years ago.

Not long after this it is believed the black and yellow races branched off. The state of opinion concerning them is too unsettled to warrant drawing definite conclusions. Of course, they have each been evolving along with the white race.

Finally we come to the Pleistocene Crô-Magnon man, of whom we know more than of any of the early races so far discussed. The Crô-Magnon was the equal of any of the human races of today. As the climate of Europe became more temperate at the close of the glacial period we find this race infiltering into Europe and displacing the Neanderthalers. He brought with him an already developed culture that indicates a long period of time spent elsewhere in evolving from some unknown, early branch of our great family tree which we are unable to supply. He was a big, tall fellow, many of the skeletons measuring six feet four inches. Otherwise there was nothing of the uncouth, animal appearance of Neanderthal man about him. The most marked peculiarity was a great width across his face at the cheek-bones, but his skeleton is constructed very much like those of modern men.

The Crô-Magnons took over the same caves they had won from the Neanderthalers, and thus in France, Spain and Germany we are able to find many of the remains of their culture. Their weapons and implements of unpolished stone are found mixed with the debris of bones and trash that would accumulate in the cave habitation of a primitive people, and many cave burials of these people themselves have been located, the skeletons often being practically intact. The ice of the great glacial cap had too recently retreated to permit of the reforestation of the landscape, so we find that these new peoples were hunting their game on the steppes, pursuing the same wild horses and reindeer their Cave Man predecessors had lived upon. The Crô-Magnons are the "Reindeer Man" we so often read of, although they, too, lived in caves. They were artists, scratching crude drawings of animals

(*Continued on page 357*)

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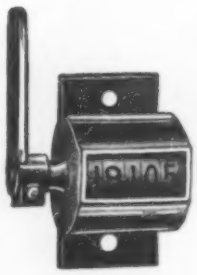

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Radio Notes

More About the WD-11 Dry-Cell Tube.—Through Mr. G. Y. Allen of the Radio Division of the Westinghouse organization, we have several interesting facts to report regarding the WD-11 dry-cell tube. First of all, this tube, which may be employed as a detector or amplifier, will stand 150 to 180 volts on the plate, successfully. The rated current consumption of the tube is 0.25 ampere, and the terminal voltage 1.1. Tests have indicated that if the WD-11 tube is used on a single dry cell two hours a night, a fresh dry cell should last from 50 to 60 hours. In terms of maintenance expense, this would amount to about 40 cents per month. We are assured that, properly employed, the WD-11 tube is the equal or even the superior of the usual 6-volt tube.

The Radiotron UV-201-A is a new and improved high vacuum tube suitable for detection, radio-frequency amplification, and audio-frequency amplification, which is now available. It contains the new thoriated tungsten filament, the characteristics of which are long life, low power consumption, and low operating temperature, and it consumes only one-quarter of an ampere (0.25 ampere). If the filament voltage is supplied by a six-volt battery, the resistance of the filament rheostat should be at least four ohms. It will be noted that the current consumption is very low; in fact, five tubes of the UV-201-A may be operated with the same expenditure of energy as is generally called for by a single tube of standard type. The UV-201-A, however, is microphonic and should be mounted on cushion or spring supports to prevent noise from vibration. The life of this new tube is usually ended by a decrease in electron emission. This is indicated by an increase in the filament voltage required for satisfactory operation.

Pick-Up Devices That are Different.—With the radio audience growing more and more critical regarding the rendition of radio programs, it has been necessary for radio broadcasters to devote no little attention to their microphones or "pick-up" devices. In the early days of broadcasting, not so long ago, considerable attention was devoted to the acoustical properties of the studio, particularly troublesome sound reflection or echo, until this phase of the new art was finally mastered. However, it has been found that the microphone or "pick-up" device is the main link between the studio and the radio audience, and no matter how perfect the studio may be and no matter how flawless may be the music at the studio end, the microphone or "pick-up" stands in the way. The usual carbon microphone is far from an ideal "pick-up" device. It misses many notes because its diaphragm, having a natural period or tone of its own, cannot be expected to vibrate over the wide range of frequencies encountered in a musical program. Furthermore, its mechanism is somewhat "heavy" and represents considerable inertia to rapid oscillations. The question of natural period also applies to the condenser "pick-up" device, in which the vibration of a diaphragm causes a change in the capacity of the modulating circuit in accordance with the sound values. Of late the General Electric engineers have been experimenting with the pallo-photo-phone device, which, it will be recalled, is also employed for recording sounds on a motion picture film by means of a photographic record. In the case of radio broadcasting, the pallo-photo-phone adaptation consists of a very sensitive diaphragm attached to a tiny mirror, which projects a beam of light on to a photo-electric or "light sensitive" cell. The cell, of course, forms part of the modulator equipment which, in turn, controls the transmitter. It so happens that the pallo-photo-phone diaphragm and mirror are so light and sensitive that they will pick up sounds which would be lost when using the heavier diaphragm and cumbersome mechanism of the usual microphone. Recently the Westinghouse broadcasters have been experimenting with the glow discharge pick-up device of Dr. Phillip Thomas of the Westinghouse research laboratory. In this "pick-up" device a high voltage glow discharge takes place continuously between an upper electrode and a lower electrode, the spark of the discharge being exposed to the sound waves. This ingenious device has no natural period and reproduces tones running from a frequency of 60 to 6000 with absolute truthfulness. Any one listening to KDKA during tests of the glow discharge transmitter, will immediately note the marked quality of the emitted music.

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Radio Notes

Telephones on Moving Trains. — An article appearing in a recent issue of *Jahrbuch der Drahtlosen Telegrafie und Telephonie* describes a method of communication from a stationary telephone to a subscriber traveling on a train which was tried on a 275-kilometer stretch of track between Berlin and Hamburg. All previously tried methods required either a very large amount of energy in the sending station or else a high antenna somewhere upon the train. The former was too costly; the latter was impossible owing to the limited overhead room in cuts and tunnels. The tests described were made by the use of high-frequency currents with wave lengths of between 3000 meters and 4000 meters emitted from a station near the main line and carried in a wire alongside the tracks. It is claimed that energies of only 5 watts to 50 watts were required to establish perfect speech transmission.

Battery Recharging by Means of a Small Motor-Generator Set is by no means a brand new idea. In fact, many garages still use a motor-generator set for recharging purposes. However, until now no attempt has been made to use a motor-generator set for recharging a single battery at home—at least not on any extensive scale. Radio amateurs and others have been using the vibrating type of recharger and the rectifying bulb type. However, there has now appeared on the market a small motor-generator set for home use, which has certain worth while features to recommend it. The motor and the generator of this set are connected by flexible coupling. There is an ammeter and a rheostat to regulate the charging rate. The motor has a ten-foot cord with attachment plug, while the generator has six-foot leads with convenient spring clips. The charging rate may be varied from one to 20 amperes, which is a wide range in handling different sized batteries.

The Kenotron Rectifier.—The development of three-element vacuum tubes for use as generators of radio frequency power has been accompanied by the requirement for a power supply of high voltage direct current, which is applied between the plate and filament of the three-element tube. At lower powers the high voltage direct current is obtained from a direct-current generator with a rotating armature. At higher voltages than are obtainable from such machines, however, it has been necessary to develop other means for obtaining this supply. The kenotron rectifier has been developed primarily for this purpose in connection with radio telephone and telegraph transmitters, although it is applicable to other uses where a high voltage direct-current power supply is required. The name "kenotron" is being applied to the two-element rectifying tube, while the term "pliotron" is being used for the three-element tube. The kenotron is similar in appearance to the more familiar three-element tube, the underlying difference being in the omission of the third or control electrode, commonly known as the grid. The kenotron depends for its functioning upon its inherent uni-directional conductivity. In common with the more familiar three-element tube, a filament, in a highly evacuated container, is heated to incandescence by the passage of direct or alternating current through it. Under these conditions the filament emits a great number of electrons, which are unit charges of negative electricity. If a potential difference is created between the filament and the second electrode, known as the plate, and the plate is made positive with respect to the filament, the negative electrons will be attracted to the plate and will enter it, causing a flow of current between the filament and the plate inside the tube, and from the plate back to the filament in the circuit external to the tube. If a kenotron tube is placed in series with an alternating current supply, it will be found that current will flow in the circuit only during every other alteration, during which the current flows from the filament to the plate. For the alternations which would normally cause the flow of current in the opposite direction, the kenotron acts as an open circuit. The output of such a rectifier, therefore, will be a pulsating direct current, each successive alternation of the power supply of the same polarity, producing a pulse of direct current. It is customary, therefore, where direct current of constant amplitude is required, to add a so-called "filtering system" in the output circuit of the rectifier, which will smooth out the ripple.

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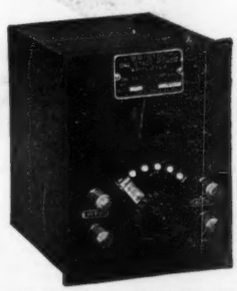

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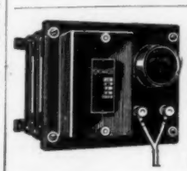

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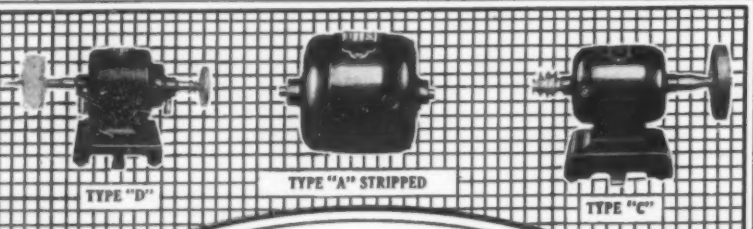

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Electrical Notes

Summaries and Excerpts from Current Periodicals

One Million Telephones in One City.—Greater New York became the world's first city of a million telephones in March, 1922. The dawn of 1923 saw 1,071,848 telephones in service in that city. In the short span of 46 years since the first telephone was installed in the metropolis, there has grown up a gigantic system containing more than 6,000,000 miles of wire, 64 buildings, and 114 central offices, requiring the services of nearly 33,000 employes.

A Trouble Finder.—An ingenious type of trouble finder has been developed by an American manufacturer of linemen's tools and supplies. This device is a coil of wire, encased in molding material, and connected with a single watch-case receiver. The lineman, holding the receiver to his ear, brings the coil close to a wire or cable in order to determine if it is "dead" or "alive." The coil intercepts the magnetic flux of a charged wire and causes a hum in the telephone receiver.

Thermionic Volt-Meter.—The vacuum tube forms a convenient method of measuring alternating electromotive forces of any frequency, because, owing to its asymmetric conductivity, an alternating electromotive force of which the mean value is zero produces a current the mean value of which is zero and which is readily measured by an ordinary milli-ammeter or micro-ammeter. Two methods of using the triode valve as a rectifier are described in a recent issue of *Engineer*.

A Renewable Plug of improved design is now available on the market. It has a porcelain base and cap, and instead of the usual metal top with mica window over the sometimes visible fuse, the top in this case is a unit of porcelain. Unscrewed from the socket, the core pulls out and exposes the fuse to full view. If the fuse has blown, a new core or refill is slipped into the porcelain holder. Thus the holder is used over and over again, and it is claimed by the manufacturers that a saving of 42 per cent of a new plug is effected in this manner.

The Recording-Demand Watt-Hour Meter.—By providing the usual watt-hour meter with an elaborate recording mechanism there has been produced the recording-demand watt-hour meter which furnishes a permanent chart showing the time occurrence of demand, the amount of the demand, and the variation of the demand. The meter makes use of a wide paper ribbon which carries perforations along both edges. A clockwork mechanism drives the paper along, while a long arm operated by the electrical mechanism of the meter and carrying a pen, marks the current consumption on the paper tape, which is printed to indicate the time interval and the current consumed. Such a meter gives an accurate record of how much current is consumed throughout a given period and indicates when it is consumed.

Electrically Produced Steam. — The system of obtaining steam from water-power plants by using some form of electrically-heated boiler seems to have passed out of the experimental stage into real engineering, according to *The Electrician*. The system has, of course, been used extensively both here and abroad, but not on the scale now recorded from Niagara, where an 18,000-kilowatt boiler has been installed. This boiler is heated by three-phase current at 12,000 volts and 25 cycles, and evaporates 54,000 pounds of water per hour at a pressure of 125 pounds. It occupies a space of 21 feet by 10 feet 3 inches by 22 feet. Its thermal efficiency is said to be 99 per cent and a full head of steam can be raised from cold in about half an hour. Situated as we are with regard to fuel, the question cannot be of more than academic interest—at least in normal times, when coal is available in ample quantities for all ordinary needs. However, such an installation indicates that there is no technical difficulty in providing either steam or hot water by electrical means.

The Neon "Glim Lamp."—The glim lamp derives its luminosity from an electric discharge between two electrodes placed together and enclosed in a rarefied atmosphere of neon gas, according to *Electrical World*. The lamp operates like an electric valve; that is to say, if a direct current potential of more than a certain critical minimum is placed upon its two electrodes, the cathode will be luminous, the anode will remain dark. If alternating current is impressed, both electrodes will appear to be simultaneously luminous. At commercial frequencies of 25 to 60 cycles the alternations of light and dark will occur so rapidly that the eye will see only a permanent glow of both electrodes simultaneously. The critical or minimum voltage to start any visible discharge is 180 volts for direct current and 130 volts for alternating current. The color of the luminous electrodes is a pleasing pinkish-orange with a blue-violet fringe on the edges. The current consumption is negligible. The shape of the electrodes can take the form of letters, so that signs may be made up of combinations of suitably lettered lamps. Assuming a consumption of two watts per letter, a sign bearing the name, "Dr. Jones" would require only about 15 watts.

Electrical Properties of Neon-Filled Lamps are mentioned in the *Proceedings* of the Physical Society. A particular type of British neon lamp which contains neon with 20 per cent of helium, takes an intermittent current when shunted by a condenser and connected in series with a high resistance to a direct-current supply. For example, a resistance of one megohm and a capacity of one microfarad on a 200-volt supply gave a frequency of about 1.2 flashes per second. When cold, it appears, the lamp fails to pass any current until subjected to an e. m. f. of about 171 volts. If, however, the voltage be reduced when the lamp is glowing the current continues to pass until about 140 volts is reached, when the current suddenly falls to zero. When an e. m. f. of 200 volts is applied, some time elapses while the condenser is charging up to the necessary 171 volts. At the end of this time the lamp begins to take current, the current increases, and the voltage across the lamp falls to the limit of 140 volts, when the lamp goes out. The cycle of operation then repeats.

When Electricity Regulates the Temperature.—While the automatic thermostat control is by no means a novelty at this late date, its use in the average American household is still rather limited, and only too many home-owners are not familiar with its numerous advantages. In brief, the automatic thermostat is a device which is placed in any room which is to be maintained at a given temperature, and serves to operate the drafts of a heating plant in another part of the house through the medium of a conducting cable. There are thermostat controls now available which are accurate to within two degrees of a fixed temperature; that is to say, a rise or fall of two degrees will operate the furnace drafts to counteract the temperature change. Heretofore most of the thermostats have made use of spring motors or gravity motors to operate the furnace drafts, and these motors have had to be looked after so as to keep them in operative order. More recent developments of automatic temperature control have brought the electric motor into the field, so that an electric motor through suitable reduction gearing, handles the drafts. One type with which the author is familiar, operates by means of the thermostat control through a three-conductor cable. The motor casing includes a step-down transformer, so that the necessary control current going to the thermostat is of a safe low potential, yet no dry batteries are required. The thermostat control in this particular type is provided with two cam adjustments, which regulate the temperature at night. Thus the cams can be arranged to lower the temperature by, say, 10 o'clock at night, and raise the temperature to the day-time requirements by, say, 7 o'clock the next morning. A clock drives the timing mechanism. Instead of shutting off the drafts altogether and allowing the house to become chilled, which is common practice, the present heat-controlling system maintains the temperature at any degree desired during the night and brings it up to the day-time requirements by morning. Once the advantages of automatic temperature control are fully appreciated, the average home-owner will certainly not do without it.

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Extinct Races of Ape-Like Man

(*Continued from page 353*)

on pieces of bone, and sometimes making quite remarkably good drawings on the walls of their caves with various natural pigments, such as red and yellow ocher. These usually depicted the animals that so fully filled the horizons of a hunting people—the bear, the reindeer, the aurochs and the bison. Some of the figures are about on a par with those of animals drawn by clever children, or by the average adult.

It is believed that the present peoples of Europe represent two invasions. First came the Mediterranean stock, having heads which, if viewed from above, would be called long. Later came the Alpine stock, with broad heads. Both may have come from Asia, or the longheads may have come from northern Africa. They came fully evolved in body and in culture. Using weapons of polished instead of rough stone, they are the first European men of the New Stone Age. Who were their ancestors? Of this we know nothing. Anthropologists have been in the position, rather illogically, but as yet unavoidable, of studying other races without having an opportunity to study our own. In other words, we do not know anything of the whole course of evolution that connects our own white race back to the early primate stem. The records probably lie in the soil of southern Asia and we have not yet got at them. The reasons for this are very practical, every-day sort of reasons, not the least of which has been the lack of money for this purpose. The results of the few expeditions that have been sent out have been meager because there is such an immense area to hunt over; because it is so far from the centers of civilization; because of the climates and half-wild tribesmen of many of the regions suspected of holding the secrets of the evolution of modern man; and, lastly, because, compared to the results to be obtained from archæological expeditions in Egypt and Assyria, there is little that is spectacular and tangible enough to the average person with means to interest him in this long search. Such work, the discovery of the stages of the evolution of modern man from the early primate stem, would require the expenditure, year after year, of the income from a quite large sum of money. Its pursuance awaits the unflagging interest of some Lord Carnarvon who will be willing to send out small expeditions to stay in the field until something is found.

On the other hand, anthropological research has been comparatively easy in Europe. It is near. The area to hunt over is smaller. And we have found much in caves that are quite easy of access. In other words, lacking the means of access to the remains of our own ancestors, we have had to be satisfied with a study, most valuable and interesting, however, of the remains of several extinct but collateral races of men and near men.

The Washington Conference Battleship

(*Continued from page 304*)

that the majority of future fights, where there is reasonable visibility, will take place at from twenty to thirty thousand yards, calling for an elevation of, say, twenty-five to thirty degrees. With this high angle of elevation the guns of No. 3 turret would not be masked, or would be very little masked, even in fire-ahead, by turret No. 2.

Another striking novelty in the Conference battleship is the masting; for in the endeavor to provide several reserve fire-control platforms, the ship carries no less than six masts, big and little. The forward tripod mast is enclosed by a lozenge-shaped plate-steel tower, conforming to the tripod, which serves to house several searchlights during day fighting, an arrangement which is now followed in some of the later wartime British battleships. Around the mainmast are grouped in triangular fashion three vertical tubular masts, each of which carries its own platform, from which the ship can be fought. The large single elliptical smokestack serves for the whole of the boiler plant. Reduction gear turbines of 55,000 horsepower developed on four shafts, serve to give the ship a speed of 24 knots.

Although we are strongly of the opinion that, in the present state of the art, and of the strategy and tactics of naval warfare, plan "A," as above outlined, will be preferred by naval officers, there will be those, no doubt, who will favor the ship shown in plan "C," which, with the same battery of nine 16-inch guns, and at a great sacrifice in defensive qualities, would have a speed of 30 knots as against 24 knots.

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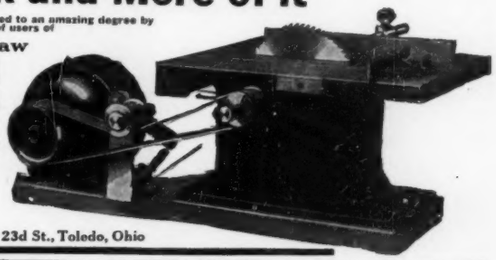

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Our Psychic Investigation in Europe—I

(*Continued from page 308*)

alive or dead, "goes to bat" whenever he feels like it, and stays as long as he wishes. One does not feel forced to believe that the sitting is what these people believe it to be, but one would respect them for conducting it on the basis which I have described. And one who has seen anything of spiritism as it is commonly practiced in America cannot help drawing a very deadly contrast.

On February 27 I had another seance with Mr. A. Though I had no desire to do so, and rather deprecated the position in which I was put thereby, it was insisted that as one who had come so far to see British mediumship at work, I should carefully examine the cabinet in front of which the medium sat, and assure myself that it was harmless. It was.

This time there was more difficulty in getting the medium into a trance condition. It was obvious that he was physically exhausted before the seance started. He insisted that the seances did not tire him, but that wheeling wheelbarrows all day did, and that he was indeed very tired. I have learned since that Mr. A works in a London garage and thinks the work is too hard for him. As a result he is quite unhappy. But he is so faithful to the idea of what he cannot properly do that he will not give up his job and take up work as a professional medium that is offered to him by the psychic group, on the ground that he could not take money for his mediumship. He is a little bit of a chap and very quiet and mild, in truth. When he whispers "No!", however, he means it. His wage is something like 25 shillings a week. He gives two seances a week to a rather restricted circle, for which he persistently refuses payment. His circle is hoping that some solution will be found that will keep him in London in contentment, but they are none too confident that he will not pack himself off to Scotland again.

At any rate, the medium finally went into a trance state, after considerably more singing and playing than on the previous occasion; and at intervals throughout the seance he called for more songs. On one occasion the trumpet voice led in this singing in powerful tones; and on another it joined in. Otherwise, the trumpet voices were weak and hard to understand. White Feather again took charge of the proceedings. The first voice claimed to be that of Peter Galloway, a recently deceased Glasgow spiritualist. One member of the group referred to his death as having occurred about six weeks before, and the voice corrected him, saying, "Three weeks ago tonight." He professed great difficulty in using the trumpet, and White Feather gloated over this fact.

A succession of voices, all extremely weak, followed, with nothing of sufficient worth to mention here. Then came Ellis Powell, a deceased spiritualist, and spoke in what I was assured was a very characteristically poetic vein. "No artist has ever painted, no poet ever imagined, the beauty of the land in which we dwell." I thought it so poetic that it seemed to me it must be a quotation. This comes close to the sort of stuff that distinguishes the usual American seance from the British style as I had met it at the first seance.

After a few more weak attempts at the trumpet, the medium arose to pass around the circle. The spirit lights again appeared, and in one or two cases were of extraordinary brilliancy. Mrs. C., an author well known in Britain, was particularly favored. One is told that if the light is presented directly to one, when he looks intently through it he will see a spirit face. Mrs. C. saw this clearly, though not in such a way as to recognize the features. In her case and that of several other sitters the presentation of spirit lights was accompanied by material contact described as that of draperies. However, the medium was entirely out of "control" here and nothing was said in description of these "draperies," which would rule out the hypothesis that they were not Mr. A's pocket handkerchief, or something equally homely. Neither the light nor the drapery was presented to me, though I saw with perfect clearness the lights that came to others.

When the medium came to me in this circulating process, White Feather referred back to his communications to me in the previous seance. Then he told me I was to make a trip over the water. This was already obvious, for they all knew I was an American, with the presumption that I should ultimately go home. But he added,

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"Not a long journey; just a short one." This put the matter on quite a different basis. Unless the medium or some other intelligence was shrewdly guessing that an American interested in psychic phenomena would not likely come to England without crossing the Channel, it looks rather like actual clairvoyance.

White Feather went on to prophesy specifically a trip to Austria and to Leipzig. Whether I shall go there or not, and whether the prediction was a genuine or a shrewd guess, I cannot say. My sponsor at the seances is very positive that my real position and my plans have been divulged to no one; that to the medium and to everybody else I am simply an acquaintance of his from America. This has, of course, been necessary in order to guard against autosuggestion of intimidation, bad conditions, hostility, etc., by the medium.

An interesting phenomena then occurred. One of the sitters was an Italian gentleman. When the medium came to him, the trumpet voice began to talk clearly in a foreign language. Careful attention assured me it was French. Several times I distinctly made out "il-y-a," and "français," and possibly "je pense." The French seemed well spoken, and certainly had no Scottish in it. The Italian gentleman understood nothing of it and asked it several times without result to "parlate italiano." It seems reasonably certain that the Scottish medium, who has been most of his life a packer, knows no French. Old White Feather was very much exercised about the spirit that insisted on talking French, saying "Me not know what this man talking about," and, "What this man say, Chief?" He was very fretful.

Just at the moment when the medium was presumed to come out from control and resume his own consciousness, an extremely large and bright light appeared. It was by far the most startling of any witnessed during the two seances. It was six or eight inches across, flat, and semi-circular or elliptical. I suppose the skeptic will attribute it to a luminous smoke cloud fraudulently produced, and as far as appearance goes it might have been that. The members of the circle, of course, identified it with the departing spirit of White Feather. It rose diagonally from the vicinity of the medium's head and floated off and up. For a second or two it retained its original brilliance, and then faded fairly fast. It reached almost to the ceiling before it became visible.

The medium was rather lame and accordingly his legs were massaged. The next day he was much worse. One of the participants, who had sat next the medium, said that on the next day he felt very weak and drawn out, and attributed this to a drain made upon him for the support of the seance. This reminded me that after sitting next the medium at the first seance I had not been able to walk nearly as far or as vigorously as was my wont, and that I suffered from backache and other physical fatigue. I do not know whether there is any connection, but I record the observation for what it may be worth.

When the Camera Turns Sculptor

(*Continued from page* 314)

as the guide plate, and is placed on a carrier in the carving machine. The carrier is a circular steel plate, mounted on a vertical shaft and geared to a worm so that as it rotates it describes a spiral. Above the plate is a longitudinal bar free to move in the direction of its length, only. Mounted rigidly on this bar is a microscope with cross hairs on the eye piece that locate the axis for the operator. The bar is supported on rests in which it slides and can be moved along by a hand lever. At one end of the bar is mounted the drill or cutter, driven by an electric motor. It is clear, then, that any longitudinal movement of the bar is followed exactly by the microscope and by the drill in the direction of its length. Opposite the point of the drill is a headstock on which the material to be carved is mounted. As the headstock rotates, any point on the material describes a spiral corresponding to the spiral described by the carrier.

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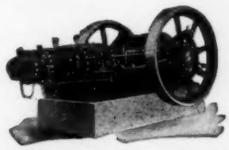

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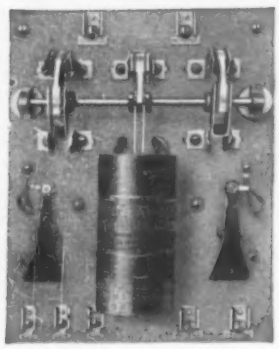

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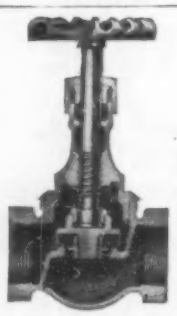

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that the intersection point of the cross hairs lies always on the same line on the guide plate beneath. Thus, as the line on the guide plate departs from the true spiral, the bar moves the drill further into or out of the material, so that it makes a depth of cut proportional to the divergence. So long as the operator follows the lines on the guide plate he cannot go wrong, and the result is a perfect facsimile of the original.

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Feeding the Soils

(*Continued from page 316*)

greater or less extent. Where it is absent the soils become sour and crops cannot be successfully grown thereon.

All soils contain some organic matter, the remains of previous crops or similar material that has been added to them. This organic matter decays in the soil, and among the products of this decay, organic acids are present. In soils in a condition of good cultivation and well drained, these acids may combine with mineral constituents of the soil, their acid nature being thereby neutralized. On the other hand, they may be prevented from accumulating to an injurious extent by drainage or changes promoted by free access of air. Where this is not possible, the addition of lime to the soil results in neutralizing the acid and promotes plant growth.

In heavy soils, containing large proportions of clay or silt, there is a tendency under certain conditions for the fine particles to become associated so closely that the soil becomes compacted, preventing free access of air and water, a condition unfavorable to plant growth. The use of lime prevents this condition and renders the soil more porous to air and water.

Lime in the form of oxide or carbonate not only stimulates the decomposition of organic matter in the soil, but brings about conditions favorable to a decomposition that will be most beneficial to growing crops.

One of the most effective means of restoring vitality to depleted soils is to grow what is called "cover-crops" made up largely of leguminous plants. The great importance of the legumes is due largely to their ability to obtain nitrogen from the air mixed with the soil in which they are situated, as well as from the soil solutions. This they do through the agency of minute organisms called bacteria, growing in large colonies upon their roots, and by irritation producing there the nodules or wart-like bodies so characteristic of them. The legume group is a very large one, and members of it are found in nearly all parts of the earth. Among the ones best known to us are peas, beans, clovers, alfalfa, vetches, lupins, locust trees, mesquite, acacia and ironwood.

In some parts of the world, especially in temperate and warm regions, these plants constitute a considerable part of the native vegetation and have for ages been adding to the nitrogen of the soil by growing and decaying in it. In some regions the legumes are principally annuals; in others, perennial herbs; and in still others, shrubs or trees.

Most of the cover-crops planted produce a dense vegetable growth above and below ground, and when this growth has been developed to the extent desired it is plowed under and the green leaves, stems and roots are allowed to decay, adding humus to the soil, in addition to the large amount of nitrogen which the growing plants secured from the air and stored in the soil. Where alfalfa is used as a cover-crop it is possible to utilize the surface plant for forage while the roots are revitalizing the soil for future crops. In California and the southwest, where alfalfa is grown the year around, it is often rotated with cotton. The alfalfa stores up plant food for the cotton, and the latter crop, by being grown in crop rotation with alfalfa, rids the soil of some of the natural enemies which prey upon the alfalfa roots when grown continuously in the same place.

Green cover-crops are extensively grown by orchardists between the rows of planted trees. Where the trees are young and not yet in bearing, the cover-crops will produce an income for the owner while waiting for his fruit crops, and when the trees come into full bearing the cover-crops keep the soil in good condition and store up plenty of humus for the trees.

The Valley of Ten Thousand Smokes

(*Continued from page 322*)

were able to go to their homes. If someone had remembered that Pompeii was only five miles from Vesuvius, whereas Kadiak was 100 miles from any volcano, and had assured the terror-striken people that nothing worse than what they had already experienced could possibly come to Kadiak, one might have greatly alleviated conditions.

The book deals with many scientific aspects of the eruption and its aftermaths, such as the climatic effects, the recovery of vegetation, the Katmai Crater itself, another discovery of the wonderful "Valley of Ten Thousand Smokes," where cornbread was baked by nature's own fires, while not far away were ash-covered snowdrifts where things that were perishable were admirably cooled. The story of the wonders seem almost exaggerated. Think of steam-heated tents and no coal bills to pay! A place where the cook never burnt anything, nothing ever boiled away, and when steam cooking was not desired other vents were found which were sufficiently hot to fry bacon and brown flap-jacks. It was all weird, uncanny, seemingly unreal. Elaborate scientific tests were carried on as to temperature, composition of gases, etc. Some of the colored plates in the book have to be seen before one can appreciate the riot of gaudy color, and pictures have even been painted using the colored muds for pigments.

Other illustrations show some of the wonders of pumice, and how bacon was fried and drinking water obtained. Of course, not a stick of wood was available, but nature furnished acceptable substitutes. The book will prove a valuable addition to the average man's library, while for those who care for nature in her wildest moods, it is indeed a treasure-house of information. The book is lavishly produced, and reflects great credit on the Society.

From Battlefield to Road Jobs

(*Continued from page 327*)

various sections are fastened securely together by the use of one-inch bolts. As soon as the concrete or stone abutments are completed, one of these rush order bridges can be erected in several days at a total cost of not over $200.

Sixteen thousand sets of artillery breast harness have been made over into hame harness at a cost of about $10 a set. These simple alterations converted harness equipments which were valueless for construction camp uses into horse trappings which were worth at least $40 a set. One State in three months saved enough to pay for the freight and the alterations on all of its army harnesses by hiring work animals without harness at $5 a day or less per team.

Over 20,000,000 pounds of T. N. T. have also been transferred to the States for road building uses, and at this writing more than 7,000,000 pounds of this explosive, which has demonstrated its superiority over dynamite for such uses, have already been discharged in paving the way for an extension of our countrywide chains of improved roads.

The Nebraska Department of Public Works very aptly expressed the appreciations of all the States which have been the beneficiaries of surplus Government war supplies when its officials said, "Financially, the State of Nebraska has been saved thousands of dollars by the receipt of this material, for by being in a position with our own construction organization to take any contract at any time, we have been able to develop the keenest kind of competition between contractors and to reduce bid prices to as low or lower than those received in other States. The war-salvaged materials and supplies have enabled us to complete 60 per cent more road building during 1921 than otherwise would have been finished. During the last year, we have built nearly 1500 miles of durable highways with the equipment received from the Federal Government."

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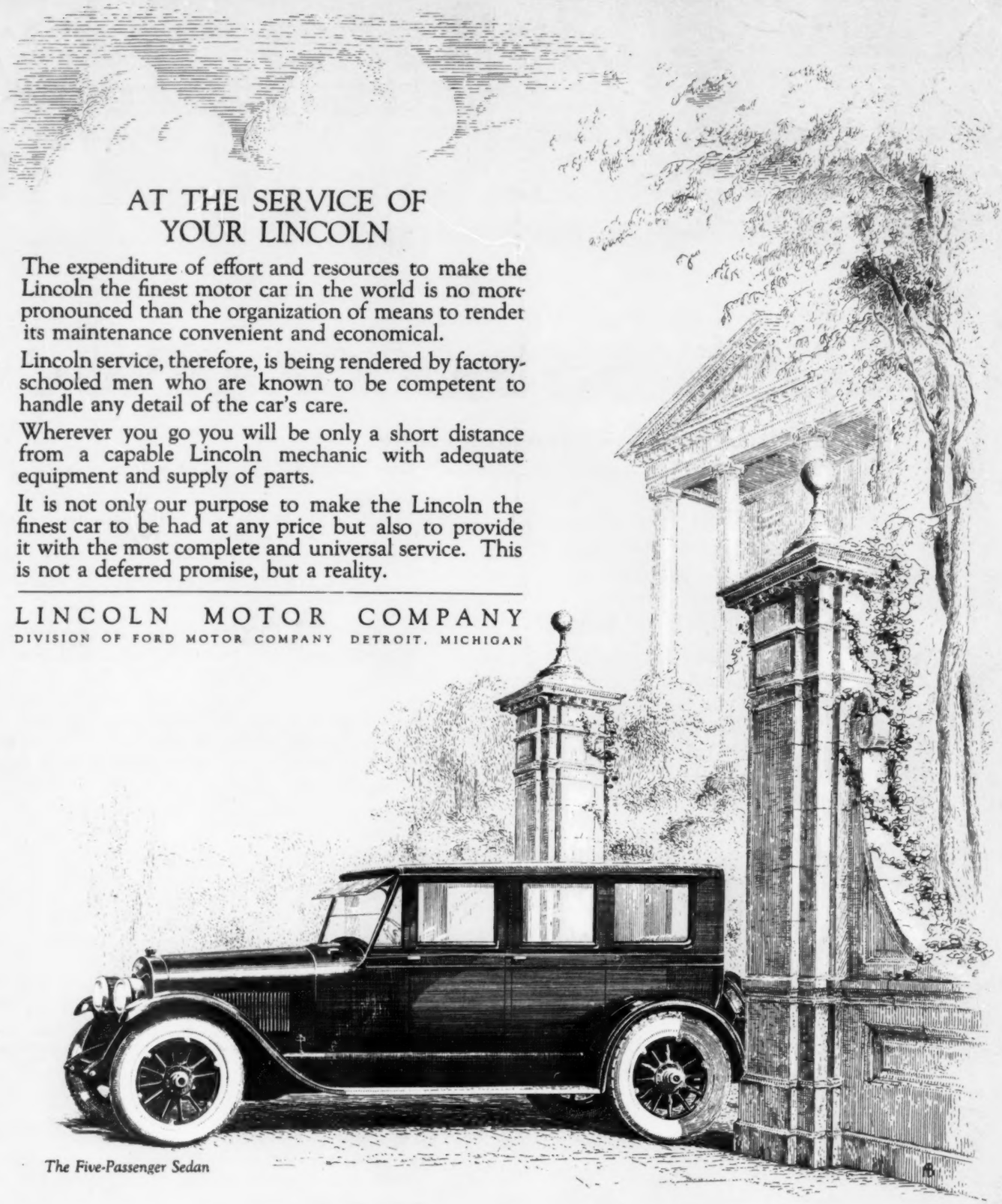

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